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Multipoint Gages

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When is a shaft or hole round? How can its roundness be determined? Ordinarily when a micrometer or snap gage fits in all positions, the inspector is satisfied. But it can be shown that a great variety of non-circular shapes will fit perfectly all positions of the micrometer. Even three-point gages, designed for a more accurate check, may not detect certain inaccuracies caused by vibration

A PIECE of work, which shows a uniform diameter when measured with a micrometer, may not be actually circular in section, and in fact, may be out of round to a degree detectable with the naked eye. The number of shapes that can be constructed of constant diameter, yet not round, is infinite.

Take an equilateral triangle *ABC* (Fig. 1) and from the centers *A*, *B*, and *C* draw the small arc *DE*, *FG*, and *HJ* with any suitable radius *r*; then complete the figure by drawing the three large arcs *EF*, *GH*, and *JD* from the same centers with a radius *R* equal to the length of one side of the triangle plus the small radius *r*. An examination of the resulting closed figure will reveal that all chords, drawn from points in the smaller arcs, through the centers from which the arcs are struck and to the opposite large arcs, are of equal length.

As these chords are normal to the curves bounding them, this figure, when tested between the parallel anvils of a micrometer, will appear to be of constant diameter. This is a simple example of figures with apparent constant diameter, but many others are easily constructed.

Such figures or shapes are produced when forces, induced by centerless grinding, turning, boring, reaming, and various other machining operations, are not properly balanced. The three-point gage was developed with a view to checking for roundness work produced by these methods. The question naturally arises, "Is there any shape which the three-point gage will show as being round when actually it is not?" Or in other words, "Is there any figure, other than the circle, in or on which the three-point gage will fit all possible positions, each point of the gage making contact with the contour?"

In the usual three-point gage for internal measurement, the three arms are of equal length and are equally spaced 120 deg. apart. Lately other gages, having arms of unequal length and unequally spaced, have been devised; further still, gages with many points, equally spaced and unequally spaced, have found occasional use. None of these gages will in all cases show whether a figure is round or not, as the following discussion will show. In fact, it will be shown that if a circle can be drawn through the points of a gage, an indefinite number of other shapes can be drawn, in or on which the gage can be placed in all possible positions, and yet each point will touch the contour at all times.

First, consider the three-point gage having arms of equal length equally spaced, that is, 120 deg. apart—the commonest form of three-point gage. It is obvious that if a three-point gage is moved within a figure other than a circle, so its points touch the contour, the center of the gage must move along some form of a path. For consider *ABC* (Fig. 2) to be a three-point gage whose

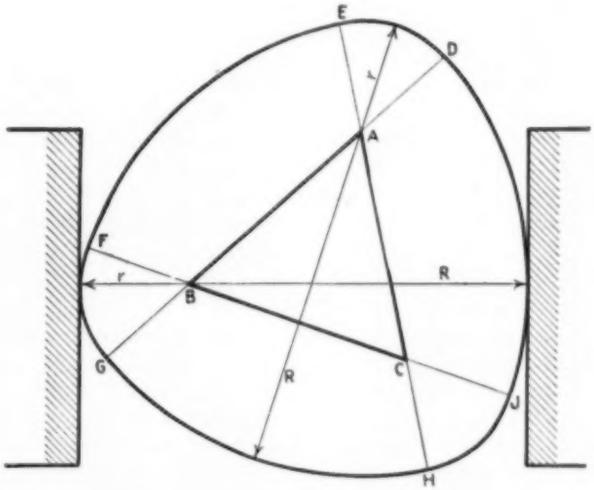


Fig. 1—Deviation from true roundness in many shapes cannot be detected with a micrometer

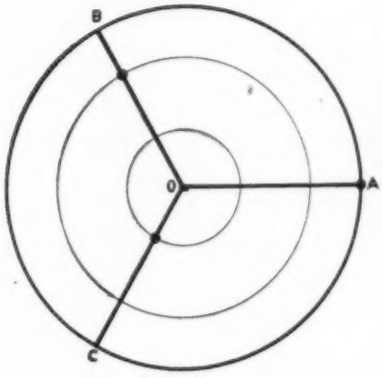


Fig.2

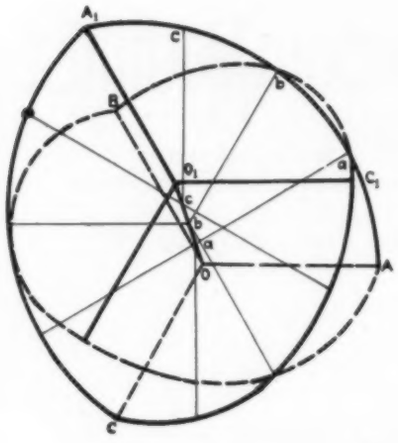


Fig.3

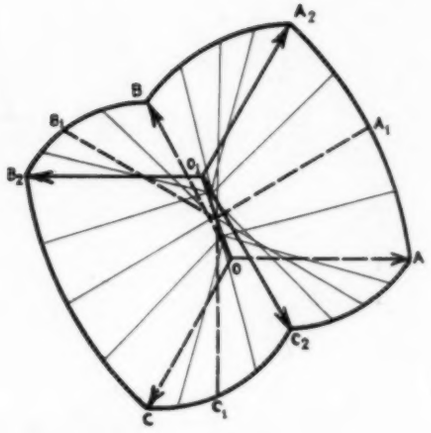


Fig.4

Fig. 2 — To fit shapes other than a circle, the center of a three-point gage must move. Fig. 3—If a line is rotated through 120 deg. while moving one end along a straight line, the shape illustrated is traced by the other end. Fig. 4—A three-point gage will fit this figure in any position with its center somewhere on the line OO_1 Figs. 5, 6, 7, 8 — These figures are generated by moving a line back and forth along a straight-line centrode while rotating it through 120 deg. The variation in shape is caused by the initial difference in angularity between the line and the centrode

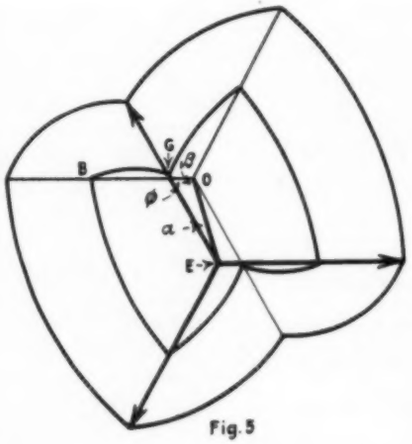


Fig.5

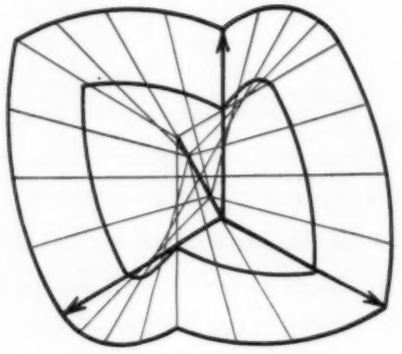


Fig.7

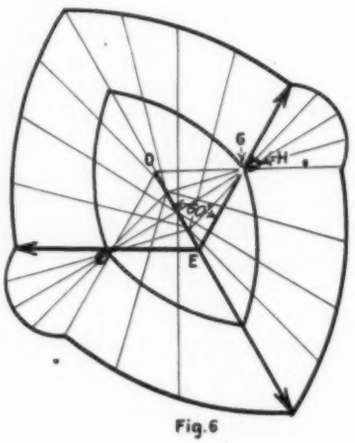


Fig.6

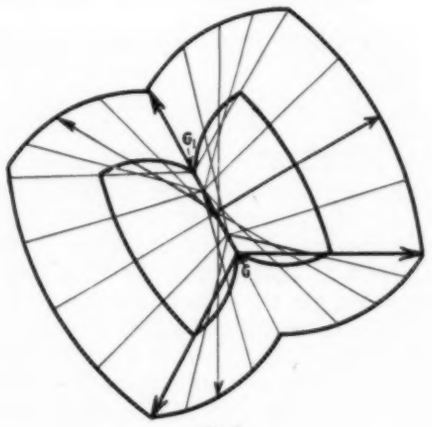


Fig.8

center does not move. To place the gage in all possible positions it must be turned on its center; thus, if the arms are equal they must describe a circle; if unequal, three concentric circles. Hence for a gage to fit a shape, other than a circle, in all positions, its center must move. This motion must bear a certain relation to the rotary motion.

Of all the paths taken by the center —circular, closed, or open curved paths, regular or irregular — the straight line is the simplest and may be called the basic path or limit of the other forms of path. Let us then examine the figure produced when the center of a three-point gage is constrained to move along a straight line. In Fig. 3, let OO_1 be the straight line and A, B, and C the gage points. When a gage with three arms of equal length equally spaced is rotated through an angle of 120 deg., each arm comes into the position that the one in front of it occupied before turning. Let us see what is produced by turning the gage through 120 deg. while traversing it along the line OO_1.

Divide the line OO_1 into n equal parts (in Fig. 3 four have been selected), and from the points of division, draw the lines aa, bb, and so on equal to OA and at equal angles apart of $120/n$, which in this case is 30 deg. When the center point of the gage has moved up the line OO_1, the arm OA will have turned through 120 deg. and will occupy the position O_1A_1 having traced out the path AA_1. The arm OC, instead of taking the position previously occupied by the arm OA, moves to O_1C_1. If the turning is continued and the center moved down the line OO_1, it will be found that the arm in position O_1C_1 traces a path, which cuts that traced by the arm ahead of it. If the movement is continued, it will be found that after two full turns of the gage, the arm OA will have traced out a closed path, which, however, crosses itself in certain places. The path traversed in the first turn is shown in solid lines, and the path in the second by broken lines. No matter

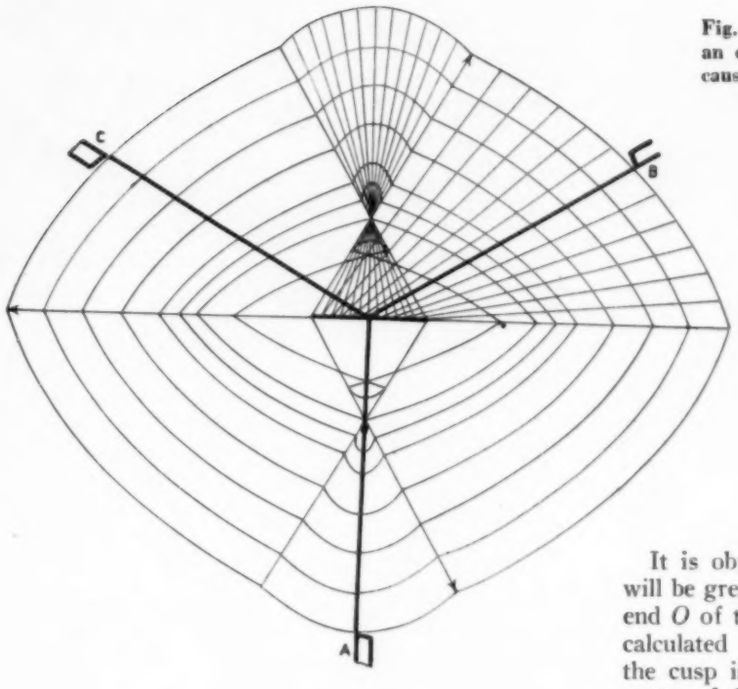


Fig. 9 — The shape illustrated gives an exaggerated idea of what may be caused by three tools arranged around the work

how many turns the gage is given, all three points will travel the path shown. Therefore, the figure is one in which the three-point gage will fit in all positions.

But since the path of the points crosses itself, the figure may be possible geometrically but not in practical work, such as a hole in a piece of metal. It may be noticed that the arm OC after a 120 deg. turn occupies the position O_1C_1, parallel to but separated from OA by the distance OO_1. If the center of the gage were moved up and down the line O_1O_1 during a turn of 120 deg., each arm of the gage would occupy the position previously held by the arm preceding it.

Fig. 4 has been constructed by rotating the gage through 120 deg. while moving the gage center up and down the line. From this we may conclude that with a three-point gage, to form a closed shape that does not cross itself, we must bring the center back to its starting point in each 120 deg. of turn. In other words, the center must make one complete circuit in a closed path, a double movement along a straight line being one limit of this. In Fig. 4, a three-point gage is shown in three positions, and it may be seen that the shape will fit all possible positions of the gage. If the gage is rotated in the opposite direction as the center moves along the line, the figure traced will be exactly the same. *Therefore in certain cases, the equal three-point gage will not show the divergence of a hole or other piece of work for roundness.*

In Fig. 4, the angle between the straight-line centrode, as the path of the center will be designated, and an arm of the gage was not made of any definite size. If this angle, α in Fig. 5, is altered, the shape of the figure changes. In Fig. 6, the centrode has been placed in line with an arm of the gage when the gage center is at the end of the centrode between the centrode and the arm. This makes the angle α equal to 60 deg. In Fig. 8, the centrode lies on an arm of the gage so the angle is 0 deg. In Figs. 5, 6, 7, and 8 are shown the limiting figures producible so the three-point gage will fit practically as well as geometrically.

In Fig. 5, the cusp G touches the arm of the gage. If this figure were made smaller, the cusp would cross the arm, so a practical gage would not be insertable in all positions. As the size of the figure depends upon the size of the arm of the gage, we will find the minimum length of arm with which the gage will fit the hole without interference. For the purposes of this article, a practical gage will be considered to be one with arms infinitely thin. For an actual gage, the limits here given will have to be altered to suit working conditions.

It is obvious that the interference from the cusp G will be greatest when the gage has its center point at the end O of the line, so the limiting length of arm must be calculated for a gage in that position. The point G at the cusp is the point at the end of an arm when the center of the gage is at E. Therefore, the limiting length of the arm is EG. What is the length of EG for all the conditions shown in Figs. 5, 6, 7, and 8?

In the triangle OGE—

OE = the length of the centrode

α = the angle between the nearest arm to the centrode, and the centrode, when the center of the gage is at the end of the centrode

$\beta = 120° - \alpha$

$\phi = 180° - (\beta + \alpha) = 180° - (120° - \alpha + \alpha)$

$= 180° - 120° = 60°$

Using the sine formula for the length of the side of a triangle, we get:

$$EG = \frac{EO \sin \beta}{\sin \phi} = \frac{EO \sin (120° - \alpha)}{\sin 60°}$$

Trying this formula for the cases as shown in Figs. 6 and 8, we get:

the limiting length of arm,

$$EG = \frac{EO \sin (120° - 60°)}{\sin 60°} = \frac{EO \sin 60°}{\sin 60°} = EO.$$

This value is correct when the thickness of the arm of the gage is infinitely small so it will pass through the infinitely narrow opening into the loop at H. The two points forming the mouth of the loop, when the length of the vector is just above the limiting size (on the outside edge of the limit), do not touch, so that the arm can enter without interference.

In Fig. 8 where α equals 0°, the limiting length of arm

$$EG = \frac{EO \sin (120° - 0°)}{\sin 60°} = \frac{EO \sin 120°}{\sin 60°}$$

But sin 120° equals sin 60°. Therefore, the value of the above expression is EO, which is correct, for the two cusps G touch the ends of the centrode, which is EO.

So we have proved that the limiting size of the arm when the centrode lies on, or opposite an arm of the gage, is equal to the length of the centrode. At other positions of the centrode, it is equal to the length of the centrode multiplied by the sine of (120° minus the angle

between the arm and the centrode) and divided by the sine of 60°.

Let us see what is the largest size of the arm in a limiting case, and in what position the centrode must be for that value. In the formlula, .

$$EG = \frac{EO \sin (120° - \alpha)}{\sin 60°}$$

we must find what value of α will give the largest value to sin $(120° - \alpha)$. We know that the angle with the largest sine is 90 deg., therefore the value we want for α is 30 deg. If we make α smaller or larger than 30 deg., the length of the arm in the limiting case decreases. The limiting size of the arm is greatest when the centrode is at an angle of 30 deg. with the arm and is equal to $\frac{EO \sin 90°}{\sin 60°}$, which equals the length of centrode divided by 0.8660254. The case of this maximum length is illustrated in Fig. 7. These limits do not refer to work measured externally, but only to holes measured internally.

One might be pardoned for saying that it is impossible for these shapes to occur in practice. Perhaps so, at least in the exaggerated conditions shown. An examination of Fig. 9, representing the same case as Fig. 6, but with the arms of the gage of varying lengths, will reveal that as the arm gets longer in comparison with the centrode, the shape gets nearer circular. This is a condition that might, and does arise in practice. For instance, tools may be arranged around a piece of work, in a special holder, at the positions *A*, *B*, and *C*, the holder, being fastened to, say, the cross slide of a lathe. This system is often used when a heavy cut is to be taken, for if a heavy cut were taken with one tool, or three tools side by side, the work might be deflected. With the tools arranged around the work the pressure from each tool is neutralized by that from the others. Should the slide be slightly loose, it may vibrate, in effect moving the point, through which equal lines drawn to the tools would pass, along a straight line. This being so, the work would take a shape similar to the ones shown, provided the motion of the slide through vibration was such that the point moved backwards and forwards along the line three times in one turn of the work. If the vibration caused the center point to move along the line 6 times in each revolution, a shape similar to that at Fig. 10 would be produced. If 9, 12, 15, 18, and so on, times, other shapes would result.

It may be wondered what would cause such vibration and induce such regularity. There are many causes, one of which is the gearing in the feed mechanism. Should a gear be slightly out of round, unequal pressure may be caused. Uneven backlash of out-of-balance in a gear may also give rise to vibration. Indeed, when we come to consider that no machine is absolutely rigid, we begin to wonder whether it is possible to produce circular work. It is well to consider the results of chatter, remembering the points raised in this article.

Sometimes the initial movement of the center along a line is caused by a hard spot in the material, presenting a greater resistance to the tool and thereby deflecting it from the work. Should a box tool, operated from the turrent of a lathe, start to cut a piece of material that has a hard spot at one side, it will be deflected slightly from the work. Once the center of the tools has been moved relative to the work, it will be moved every time that hard spot comes to the same place, producing work which is out of round. As the box tool progresses, the deflection becomes smaller and smaller, making the work more circular at the chuck end than at the outer end. The work then presents a twisted polygonal shape, the twist being caused by gradual alteration of the direction of vibration in relation to the work. These twisted polygonal shapes actually occur. Under certain conditions, shapes between the ones dealt with here and a circle will be produced; the variance of some of these from roundness would be detectable by a three-point gage. Illustrations are freely given to show that a slight alteration in conditions will sometimes give great differences in results. For instance, the shape in Fig. 10 is greatly different from that in Fig. 9, though the only difference in conditions is that for Fig. 10 the movement along the line is twice as great for the same angular motion.

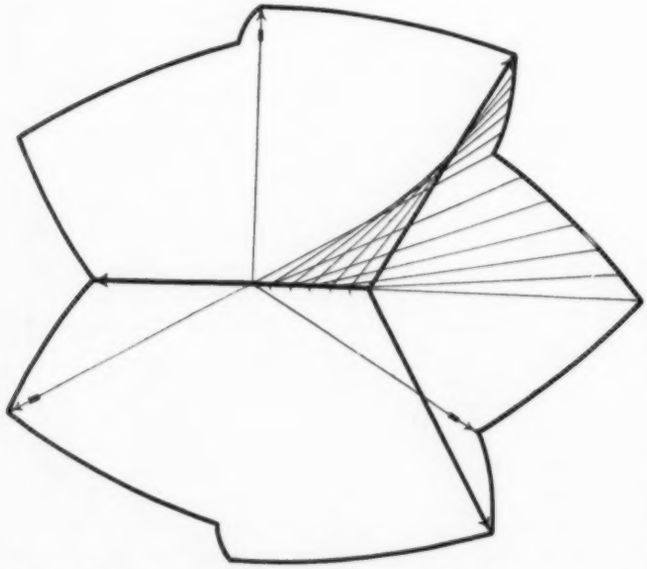


Fig. 10—This figure was developed under conditions similar to Fig. 9 except that the work center has moved forward and back twice during a 120-deg. turn

First of a series. The second will appear in an early issue.

Standard Sizes for Catalogs and Data Sheets—*Discussion*

CARL GOERNER
Stuttgart, Germany

IN AN ARTICLE under the title given above, on page 42, Vol. 74, of the *American Machinist*, Warren F. Manthei advocates that all catalogs and data sheets be of one standard size, and suggests that the size be 8½x11 inches.

This suggestion will not be universally acceptable because the size is quite unusual in those countries where the metric system is in use. It is, therefore, proposed to make the standard size for catalogs and data sheets 8¼x11¾ in. These dimensions correspond closely to the metric size of 210x297 mm. already widely used in other countries. Should this size be too big in particular cases, then one-half the size, or 5⅞x8¼ in., could be selected This size is twice that of the world postcard, which is recognized by the postal union for world correspondence

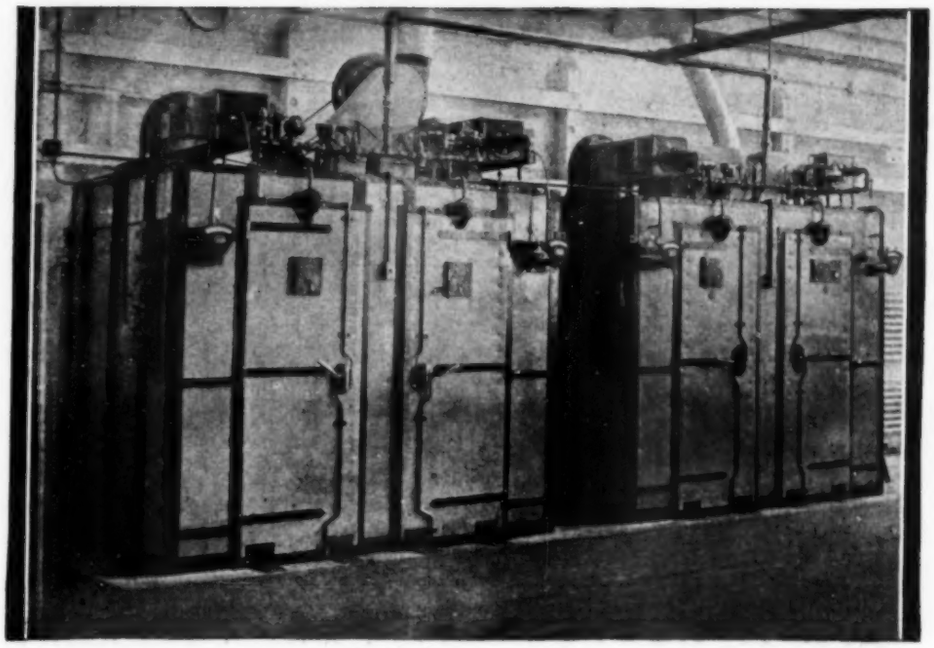


Fig. 1 — Lithographed sheets are baked in these four cabinet-type ovens with gas-heated air directed across the stacked sheets to assure uniformity in the product

Custom-Built Finishing Equipment

While standard units and general design principles are recognized, each installation must be engineered to suit the particular requirements of individual finishing problems

A. E. MAEHLER
General Manager, The Paul Maehler Company

▼

TO BE most effective, equipment for finishing metal parts in large quantities should be basically designed for the particular work involved. What may be suitable for one class of products or finish is entirely unsuitable for another. Each installation must be engineered as a separate unit. If the building is new and no other apparatus is installed, so much the better.

Our company recently had the opportunity of designing and building all the washing and finishing apparatus installed in the Clybourn Ave. (Chicago) plant of the Crowe Name Plate Company where a floor was taken over to handle the enlarged automotive supply division of the company. This installation exemplifies not only the necessity of custom-built machinery, but also the diverse type of equipment needed to treat even closely related products.

Production is divided into two sections: the lithographing sheet department and the garnish molding department. In the former, large volumes of lithographed sheets are coated and baked for vanity cases, speedometer and other meter faces; in the latter, garnish molding and inset panels for automobiles are produced.

Lithographed sheets are stacked horizontally on close-center shelves on caster trucks, and are baked in cabinet ovens, Fig. 1. There are four sections to these ovens, each of which has a capacity of 200 sheets per bake. The colors are generally white or of delicate tints, part enamel, part lacquer. All are similarly treated by direct circulating gas heat developed in separate gas heaters on the top of each oven and conveyed by fan pressure to plenum chambers located on the sides of the ovens. Perforations in these side walls which match in line with the sheets in the trucks allow the heated gases to be driven across the sheets from one side to the other and recirculated back through the heater. A portion of the fumes and gases is exhausted to the outside by a suction fan on each pair of ovens. With such treatment, the uniformity of the product in this department is exceptional, and the rejects are of a negligible percentage.

In the molding department continuous types of equipment are installed, because of the much larger production. After forming into shapes preparatory to enamel coating, the garnish material is brought to a 60-ft. rain spray washing machine, where the work is washed, rinsed, dried and delivered cool to the unloader, which is a two-strand bar flight type, with molding flights at 6-in. pitch,

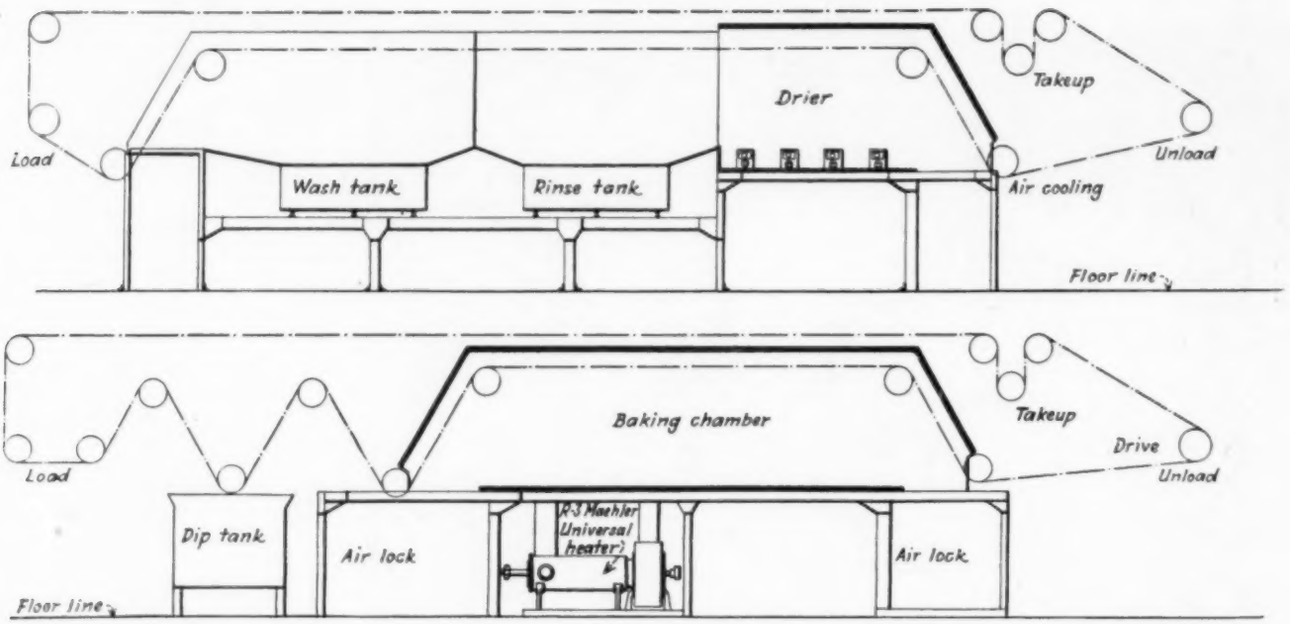


Fig. 2 (Top)—Diagrammatic sketch of the washing machine and dryer. A recirculating centrifugal pump delivers a high-pressure rain spray on the work in transit. The chain is a two-strand bar type with molding flights at 6-in. centers. Fig. 3—Washed work is hung on the horizontal two-strand conveyor that takes it through the prime-coat dip and insulated baking chamber

and will handle up to 5,000 pieces an hour. The machine is of the latest design, elevated flat A-type with counter-flow of hot air from the drying section. A 600-g.p.m. centrifugal pump delivers hot water at 35 lb. per sq.in. to the work in transit, back through baffles and automatic skimmers to the water reservoir. This reservoir is gas heated with a 6-in. steel pipe immersion coil to a controlled temperature of 150 deg. F. Machines of this type are designed to clean by pressure-velocity rather than boiling water temperature.

In the drying part of the unit, there is a two-pass vertical section built of 3-in. insulated panels and heated to 400 deg. F. by high-pressure gas burners with fresh air intakes.

To insure uniform production of thoroughly cleaned parts, complete automatic control of all elements entering into the operation of the washer is provided, such as gas volume control of the drying oven, water level control of both tanks, automatic volume steam control and temperature control of water in both tanks, exhaust of vapors corresponding to the volume set up, and trappage of foreign particles and dirt in the water tanks.

Upon leaving the washer, the stampings are inspected and loaded on a prime coat unit operating in the reverse direction. This is a standard horizontal-pass, two-strand oven, 50 ft. in length, and is known as an airlocked horizontal-flow type with a constant circulation of air handled in suspension within the oven. The heating source is of the recirculating type in which the direct products of combustion are distributed to the oven and a large part of the fumes recirculated through the heater flame for incineration, thus conserving fuel.

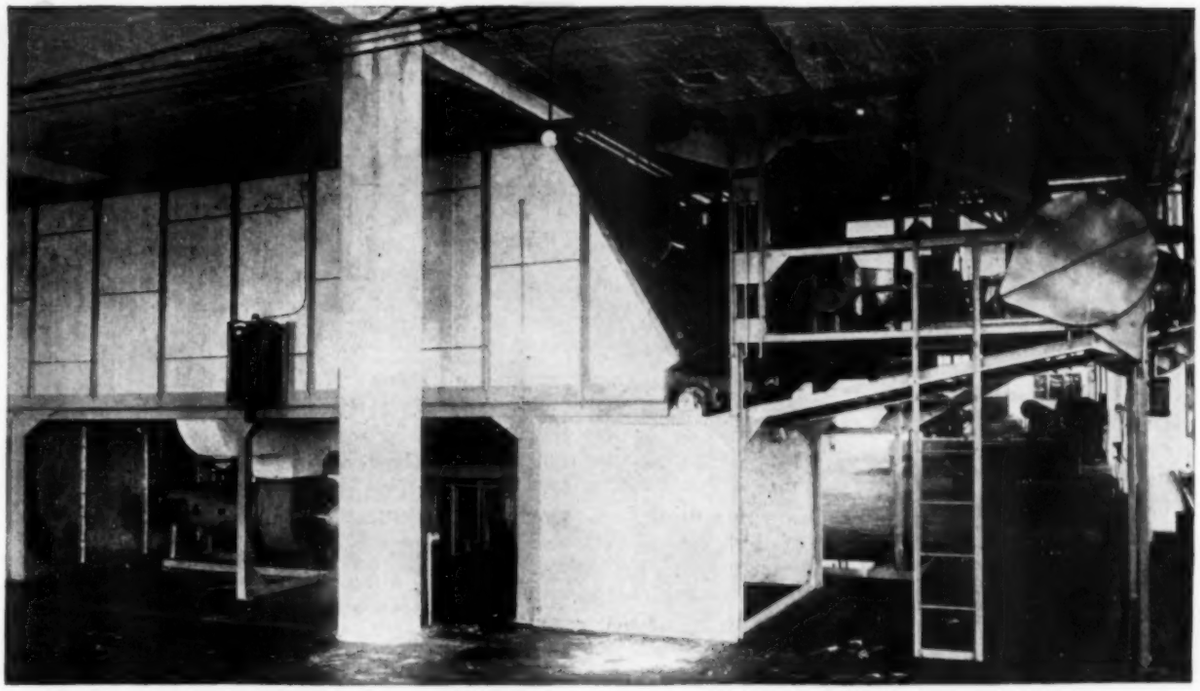
An insulated recirculating duct system is provided which exhausts the vapors given off by the work in transit at approximately 350 deg. F. to the body of the heater and through its burner, where the atmosphere is purified, revivified with fresh air, and returned to the oven in a volume which insures a constant circulation of oven atmosphere through the heater approximately five times per minute. Ventilation is very nominal, as the system is only a gravity one with an exterior stack, indicating a thorough incineration of the oven atmosphere as it passes through the heater.

The heater is a double-steel-jacketed and insulated type with a single low-pressure burner and a carborundum throat. Being of the suction type, it is fitted with a double-steel-housed and insulated high-temperature fan, with an air-cooled shaft. Temperature is controlled by a thermostat electrically connected to a control valve.

Ability to handle primers of any shade is provided by full automatic temperature control at temperatures variable at will from 150 to 450 deg. F. In the same control cabinet on which is mounted the thermostatic controller of the oven, there are other control devices that assure safe operation of the oven under any conditions of interruption, such as low gas pressure, current failure, ignition failure and fan failure.

From the prime coat unloading station the work proceeds to inspectors and through rubbers' and polishers' hands, on to the graining department where imitation wood finishes are applied by a Sherwood machine. Immediately thereafter the work is placed in a continuous steam-heated conveyor oven. In this unit, which is also used for baking clear lacquer in a later operation, the distribution system of hot air is indirect. Continuously filtered air is drawn in by an exhaust fan and forced through Arco-blast steam coils before being distributed through ducts so placed as to obtain uniformity of baking. The dipping end is entirely enclosed and is provided with drain pans, removable roller tanks for the lacquer and a special ventilating system, Fig. 3, as well as a Lux fire protective system.

Bottled CO_2 gas under constant pressure is concentrated at one end of the plant and is piped to the various units by copper and brass tubing. In the event of fire, the gas is discharged automatically by quick-acting Lowe



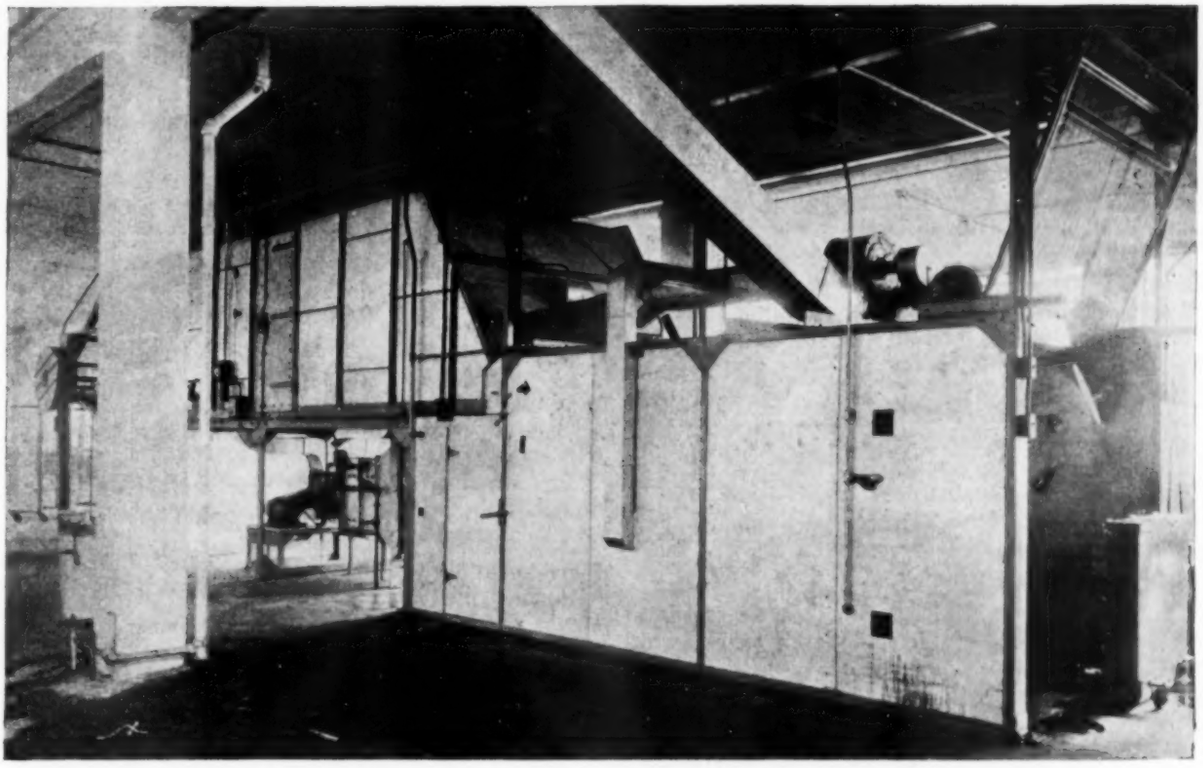


Fig. 4 (Top)—Heated air and fumes are recirculated through the gas-fired heater shown underneath this prime-coat conveyor oven. Drive of the bar-flight conveyor and adjustable take-up sheaves is seen at the right. Complete automatic control and protection are provided. Fig. 5—Indirect heating of the filtered air by steam coils prevents contamination of the work in this dual-purpose unit, which is alternately used for grain coat drying and baking clear lacquers. When not in use, the covered lacquer tanks can be rolled out

releases, thereby smothering the flames without injury to the enamels in the tanks or to the product. At the same time all conveyors and fans are stopped automatically.

In the same department and alongside the washing machine are two stripping tanks for cleaning off enamel from old stampings or rejected molding. These tanks are gas heated and are enclosed with shields and canopies to exhaust the steam outside. For economy and comfort of the operator, the tanks are jacketed all around with 1½ in. of insulation covered by galvanized sheet steel, and are fitted with drip troughs around the top.

There is also a sample creative room in which sample moldings are coated in new modes. For this experimental work there is available a small gas-fired cabinet-type oven.

The Foreman's Round Table

Service de Luxe

"COME ON, Al, I'm going to buy you a drink," hailed Ed, as he met his friend at the gate.

"A drink of what?" questioned Al.

"What do you care as long as it's wet and costs money?"

"Well, all right, but why the unusual generosity?"

"I'm celebrating. This week is the first time for months that I have had enough work in my department to keep half my men busy. I've worked like a slave and believe me it's a relief. Didn't some guy write about the blessedness of work? Or was it the dignity of labor? I don't care which it was, I never realized how restful it was to be tired before."

"Someone told me that stainless steel was hard to machine. How about it, Ed?"

"They're loco. I haven't noticed any trouble, and none of the men have said anything about it to me."

"They wouldn't. I bet they have slowed down their speeds and feeds and never said a word about it."

"Maybe. I wouldn't blame them if they did, but I'll look into it tomorrow anyway. What are you going to drink?"

"Oh, make it beer—birch or root. Say, it looks like this new order would keep us going for a while, don't it? Williams told me that we had been promised another order if we got this one through on schedule. It means overtime, I guess."

"Overtime? My gosh! From the sublime to the ridiculous. For months we lay off men, and talk about a shorter work day. Then we get a little order, and we jump right into overtime. No wonder management is criticized."

"You surely are a grateful cuss, Ed, We have a chance to give most of our men a sixty-day job and you kick."

"Yes, but why not spread it out? It may cost a little more, but the company don't have to make the last cent of profit."

"They won't, don't fear. This is an emergency. Stainless steel is still largely a novelty and brings novelty prices. The customer wants to get the jump on his competitors. You will doubtless be tickled to find that it gives Williams a chance to issue another notice. One that he has wanted to try out. I believe the suggestion came from your department, Ed."

"What is it? Tell me the worst."

"Well, as I remember it, someone in your department sent in a suggestion that toolcribs be opened before the whistle blows. He said sometimes he did not get to work until fifteen or twenty minutes after the second whistle blew, and it cut down his piece-work earnings. Williams is going to try the experiment of opening the main toolcribs fifteen minutes ahead of time, and the smaller ones ten minutes early. They will also remain open fifteen minutes late at night, so that men will not have to stop work early in order to turn in important tools. How does that strike you?"

"Well, if the suggestion came from any other source I would say it was a rotten idea, that no man would go to the toolcrib before the whistle, or after quitting time; but as one of my men made it, I will say that it is entirely practical."

"Boloney."

Will men get their tools out before the starting time if given the opportunity? Will such an arrangement tend to prevent men quitting before the whistle?

Discussion of Former Topics

Tolerances

While the engineering departments establish tolerances when designing some particular part or machine, the shops, in practice, very often find that they can get by with greater tolerances than are actually allowed. Consequently they take liberties in increasing the tolerances slightly here and there on various dimensions. This liberty, we realize, should not be taken, but there are very few shops that will not take liberties, even though they do not know the real function of the machine or part, and whether or not the tolerances should really be held.

Very often it will be found that a shop is working some parts to a greater accuracy than the drawing calls for, and others not so accurate. This condition is established in nearly every shop, consequently they get into the habit of taking liberties with tolerances.

In theory, tolerances appear to be easily established and maintained. Therefore, draftsmen very often ask for tolerances that are unnecessary. When we stop to think that it takes years of experience to make a good draftsman along any particular line, how can we expect them to tolerance everything correctly? Can anyone establish tolerances that would be absolutely correct to meet all conditions in manufacturing and in the field?

Then as to the shops standing for tolerances established by engineers. As previously stated, the shops do not know the function of the machine and they are usually afraid to say they know more about what tolerances should be on a piece of work than the engineering department. Later they take liberties. This we realize should not be done, but I have not yet worked in a shop where it was not done, and I have been in a good many shops. And in some, if they had held strictly to tolerances established, the parts would have been too expensive to machine. It might be asked here, why do not the shop and the engineering department cooperate more closely? To me this seems impossible, due to the fact there are times when neither the shop nor the engineering department knows what the exact result of a tolerance will be.

Now in regard to the inspection department passing parts that are not up to tolerances: Inspectors are apt to use what they believe to be good judgment, and you cannot blame them for passing pieces at times that are not exactly to tolerance. They do not always know the thoughts of the designer, nor the function of the parts.

—A. HALLIWELL, *Superintendent, General Iron Works Company.*

On Again, Off Again

It is my opinion that a blanket rule, while perhaps workable, is not desirable in the matter of rehiring former employees who have quit of their own accord. I think it better to leave the matter to the one who is actually going to have the supervision of the prospective employee. It has often been disclosed that a man with a perfectly good record, which to the uninitiated would warrant his automatic rehiring, is not desirable because, after he has left, a certain agitation and unrest in the ranks has gone with him. Whether he could definitely have this pinned upon him as a responsibility may be questionable, but "safety first" at least dictates that well enongh be let alone. Again, changing machine practice and administrative policy may show to one who knows a man and his work intimately that, while he was good under the former conditions, he would not be likely to fit in as well under the new.

I don't believe that any blanket rule will restrict quitting. At the time a man is considering such a proposition, he never thinks of the possibility that he may want to come back. To him the new job is not only permanent, but it has all the glamour of unreality surrounding it.

—E. L. FAIRALL, *Naval Aircraft Factory.*

The Deadline

The Williams' plan of classifying and grading men eligible for vacation with pay has much to recommend it, and the concerns that follow this system ought to clear up a situation which has afforded the shop "lawyer" a topic of discussion since time immemorial.

This privilege, and it is a privilege, although many salaried men have come to regard it as a right, should only be granted to men who are considered key men of the organization, leaders of each particular unit in the scheme of production, whether it be in the office or shop.

While a vacation is essential for the physical well being of every worker, regardless of status or type of labor, mental or manual, its need is greater in occupations which require intense application to detail and painstaking accuracy. These requirements have to be met in the executive, engineering and tool making branches.

While routine work is an indispensable aid to production in the office as well as the shop, I see no reason why the office man should be favored more than his overalled brother who faces accident hazards and discomforts to which he himself is immune.

The Williams plan would rightly classify the routine clerical worker with the routine shopman as not eligible for vacation with pay.

—ROBERT S. ALEXANDER.

Taking a Gamble

We read many assertions regarding the hiring and firing of men, overhead, of fairness to men employed, of how we must change our methods of doing business.

Behind the curtain where the lime light cannot penetrate, what do we find? One firm has a written contract that a man loses three days, one week, or two weeks' pay if he does not give notice that he is going to quit, but you cannot find in the

contract that the firm must give two weeks' notice, nor two hours even.

It is a rare thing to find a shop giving the workman any notice whatsoever. It is generally, "go in and get your time. You are through." And that within fifteen minutes of quitting time. In the office it is equally bad, except with the heads of divisions, as it were. In the engineering department, many firms allow two weeks' notice. Once in a life time you will find a shop that will give two weeks' pay.

Some shops pretend to have a rule that they will not hire men away from other shops in the same town, but just watch them. A man lays off, goes to another shop. "O yes, come two weeks from today. Take a week's rest." In the engineering department an advertisement is used, Blind. No address. It is worded, "Man at present employed preferred." That man may fit into his present place and might not fit into the new place, but he must be employed. How the firm would kick were some firm to hire men away from them in the same manner.

An employee of the engineering department saw an advertisement. "Asst. Chief Engineer wanted. (Our men know of this advertisement.)" He answered. A week later he was called into the office. "We understand that you are dissatisfied"? (How did they find it out, I wonder.) "Not exactly, but I would like a better position." "Why did you not come to us instead of answering a blind advertisement?" "You, through my foreman, know of my ability. If you would not promote me without my coming to you and declaring that I was dissatisfied, you should not object to my trying elsewhere. I was honest and gave your name as one of my references." "We don't want to keep any dissatisfied employees. You may get your time at noon. By the way, that was our own advertisement you answered."

Joe Black will get fired just as sure as the Devil made little apples. There is no help for him.

—S. B. Bilkx.

Direct Action

The fact that Williams is in charge of the works makes him a desirable member of the board, because his stewardship includes the major part of capital and because his efforts make so direct a contribution to the cause for which the company exists, namely, the dividend. If the two "Vices" are interested in the welfare of the firm and not merely giving their services in return for a salary, they will realize that Williams is, in the truest sense, their paymaster. They should offer him a cordial welcome to the directing board.

—D. A. Dunston,
Durham, England.

Share and Share Alike

"But suppose, Al, a man quit after working nine months. What then?"

"Treat him like a stockholder. If he sells his stock, does he get a dividend?"

So concludes Al after suggesting that a man's pay should rank for the same dividend as investors' stock.

Just as an investor, if he disposes of his stock, can transfer it either ex-dividend or cum-dividend, the amount he receives depending on anticipated dividends, why should not the man's final pay be either increased by the dividend anticipated or paid ex-dividend, the dividend to be paid to him later?

To make the case analogous, the man should, when he quits, have added to the value of his labor (stock) the estimated dividend, if he has sold his labor cum-dividend, or the pay only should be given him, if he sells his labor ex-dividend.

—Harry Shaw,
Lancashire, England.

The fair apportionment of the returns from a business enterprise is a problem that has baffled many minds, but the equal sharing method is a solution hardly likely to find favor. Many factors contribute to the success or failure of a business in which the workers have neither any voice nor measure of control. Bad purchasing, poor salesmanship, too many non-producers, expensive design, etc., all can materially diminish profits earned through the efforts of the man in the shop. Obviously the reverse of this is equally true. The best of management can be nullified by discontented or inefficient labor. Equal sharing presupposes also some understanding as to the ratio between the capital in the business, and the wagebill.

Obviously, dead money in a concern is bound to have an adverse effect on the return per individual. If you have $500,000 invested in a business when, say, $300,000 would be sufficient, then the extra $200,000 is dead weight and makes it more difficult to pay a dividend on the remainder. On the other side, equal sharing would scarcely be fair to the stockholder. The return on any investment is usually proportionate to the risk involved, but this hardly applies to the employee. Granted he invests his time, but he gets priority on his return in the form of wages, and even if it isn't as much as he feels he is worth, he is in a better position from the aspect of investment return than is the stockholder.

—T. H. Hargrave,
Lancashire, England.

Tolerances

I feel that Al is partly right in saying that we do not get what we think we do from machines. This means that in the course of time the "physical" tolerance demanded by the inspector on assembly is only obtained on a sufficiently high percentage of the work when the machine man is working to a closer design tolerance. If the inspector finds that too high a percentage of the work is failing on the assembly tolerance, his complaint has the effect of causing the design office to reduce the drawing tolerances as the easiest and quickest way of adjusting the matter. This solution is only found wanting when conditions change and the inspector in the manufacturer's employ is replaced by a customer's inspector checking closely to specification and drawings. Where this condition obtains, wholesale rejections must be expected unless tolerances are liberal.

The general standard of inspection allowed this particular order to get past with the tolerances exceeded in 90 per cent of the parts, but still, I venture to think, within the inspector's usual margin above the drawing tolerances. If the inspection department had their attention drawn to the importance of adhering strictly to the drawing the trouble would have been found out without the company's reputation suffering.

The essence of the trouble is that the shop rather prides itself on performing, somehow, whatever the office calls for, and to this must be coupled the fact that the shop is diffident in starting detailed discussions with the office about shop troubles.

—S. A. Knight, *Kirkuk, Irak.*

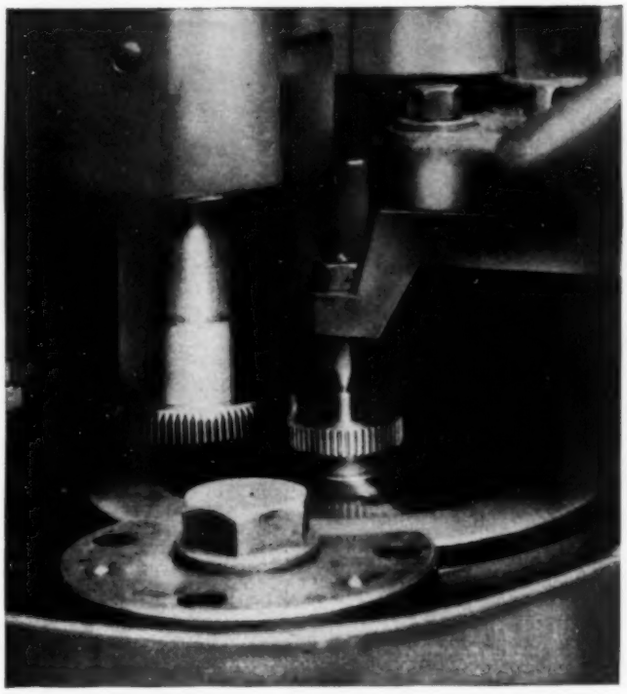


Fig. 1 — This chuck, attached to the work-spindle, can be depended upon to hold the work closely concentric

Standard vs. Special Machines

Suitable fixtures often eliminate the necessity for single-purpose machines without sacrificing production savings

DOUGLAS T. HAMILTON
The Fellows Gear Shaper Company

THE production department of any manufacturing plant may be called upon at times to choose between two courses: Shall the work be machined on equipment specially designed for the purpose; or shall standard machines be used with special fixtures? Manufacturing methods have passed through the stage where it was thought desirable and necessary for low production costs, to machine work on equipment specially designed for a single purpose. The general practice at present is to use standard equipment as far as possible, and through the medium of special fixtures, adapt this standard equipment to specialized production operations.

This method has the advantage over the use of a single-purpose machine, in that if there are any changes made in the design of the product, the only change necessary in production equipment is to redesign or rebuild the fixture. It has the added advantage of keeping the cost of the production equipment down to a comparatively low point while still possessing sufficient flexibility to take care of low cost high production requirements. In the following will be illustrated and described some interesting applications of special fixtures to the High Speed gear shaper for handling a variety of work.

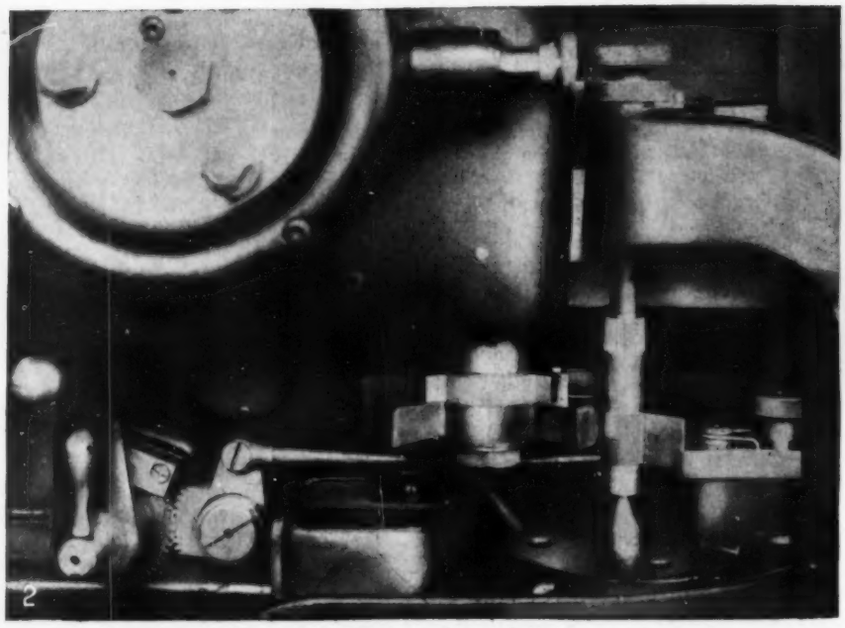
One fundamental requirement for accurate production is that all operations as far as possible be performed with the work held either as when in use, or located from the same point for all operations. For instance, if the work to be machined is provided with centers, and if all previous operations are performed using centers as locating and supporting points, then any subsequent operations, such as gear cutting or grinding should be handled in the same manner.

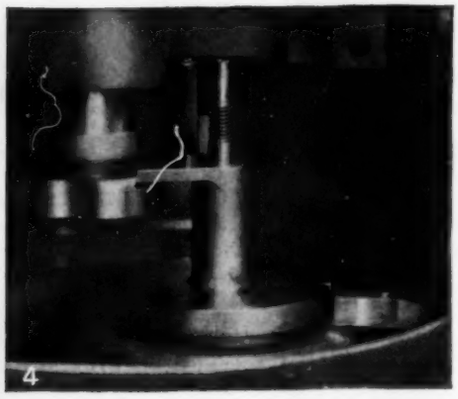
The question of accurate and rigid support for the work is of course of prime importance, and deflection should be reduced to a minimum. In Fig. 1 is shown a method for holding and supporting a small gear for an electric drill. This gear, when in use, is supported from one bearing and is so held when cutting the teeth in a special chuck. To prevent any deflection of the work when cutting the teeth, the arbor support illustrated is provided, and the work additionally supported by a center. The chuck is provided with three clamping jaws operated by a cam ring. Fastened to the cam ring is an external gear, and meshing with it an operating pinion, the latter keyed to a stud machined at its upper end to fit a wrench. Rotation of this stud turns the cam ring, and through the medium of the three cam surfaces, forces the jaws toward the center to clamp the work. This fixture illustrates a principle that is specially adapted to the holding of small pinions, in that it assures cutting the teeth concentric with the shank or bearings.

A fixture which illustrates the point previously mentioned regarding holding work from the same point for all machining operations is shown in Fig. 2. The part being machined is a shaft for a hydraulic shock absorber, and the operation is the machining of the semi-cylindrical surface. This surface must be accurately machined, as the fit desired must be oil tight. The work is supported on centers and located with relation to the fixture and cutter by a locating block which grips the vane of the shock absorber shaft. The cutter is a plain two-lobe circular cutter held in a definite relation to the work by a keyed bushing on the cutter spindle. The key in this bushing fits in a slot in the top face of the cutter.

The cutter must stop automatically when it reaches either side of the vane. This is accomplished through the medium of a kick-off attachment which consists primarily of projecting buttons held on the fixture retained on the work spindle, a connecting lever segment, and gear. The gear is retained on the belt shifting lever, and is in mesh with the segment attached to the kick-off lever. As the button reaches the kick-off lever, it forces over the lever, turning the gear which in turn releases the catch allowing the spring on the belt shifting lever to shift the belt to the loose pulley. One complete rotation of the cutter finished two pieces.

The tripping mechanism just described has many





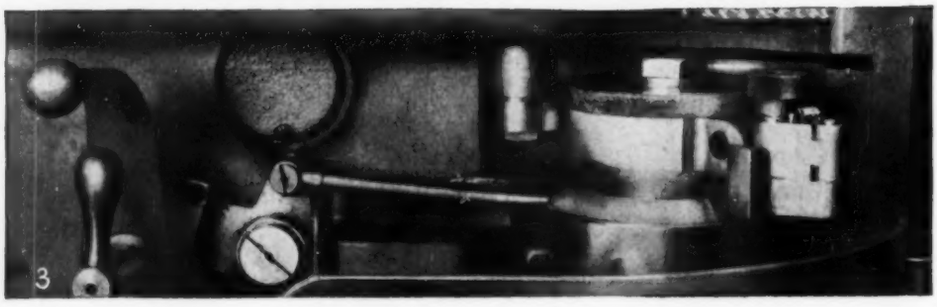


Fig. 2 — After the work has been properly located and clamped, the operator pulls out the belt shafting lever, and the tripping mechanism automatically resets itself. Fig. 3—Two work pieces are kept out against the locating stops by spring actuated fingers and are clamped by a collar. Machining is done with a plain circular disk cutter without teeth. Fig. 4—Two settings are required for machining the cams, and two gages are necessary because of the angular relation of the cams to each other

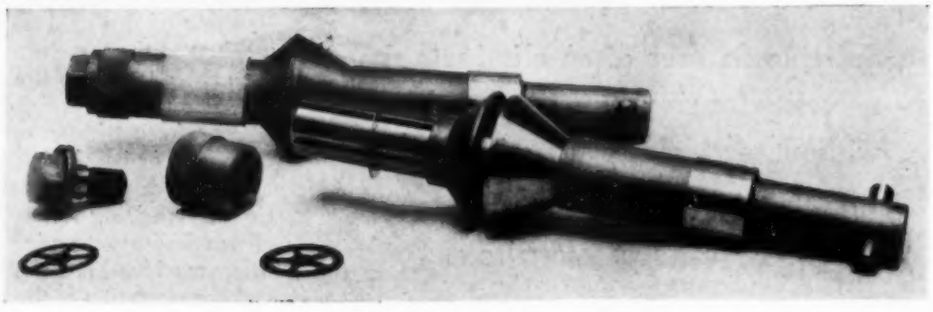


Fig. 5 — To hold these blanks, when cutting the teeth, requires the use of special arbors, slotted to clear the arms of the gear blank, and fitted to the "internal diameter" between the blank arms

possible applications. Fig. 3 shows the set-up for machining a two-piece clamp for an airplane propeller. This clamp must be in practically perfect balance, and as it is made from forgings, must be machined all over. Because of the projecting lugs, the machining operations are difficult, and the finishing of these two parts, with the exception of the bore, are all handled on the High Speed gear shaper.

The first operation consists of finishing the boss on the hinge end of the clamp. The work is held on an arbor in the work-spindle, and supported by an arm provided with a locating stop. The machining is controlled by the kick-off mechanism previously explained.

The second operation is the machining of the lug on the clamping end. Here the work is held as before on an arbor and supported in a fixture, comprising a locating pin fitting in the hole in the hinge end of the segment and a removable clamp operated by a thumb nut. Fig. 3 shows the final operation, which is the machining of the external circular surface. This requires a more elaborate fixture than the preceding ones, because two pieces are held at one time.

Work of irregular shapes can be taken care of in many cases by using a special gear shaper cutter, but where a cam, for example, must bear a certain relation to a gear or other part, a special fixture is generally necessary. Fig. 4 shows a set-up for machining two integral cams for a portable gasoline engine. These cams, of course, must bear a certain relation to each other and to the gear, which is made integral with the shaft. The way in which the lining up is done is shown. Special gages are supplied which contact with a fixed stop on the work-spindle, the latter also forming a locating point for the gear. These gages have an extended arm which lines up the cutter, the latter being provided with a flat, as shown. The work-arbor is supplied with an arbor support to preserve true alignment.

In cutting the teeth in gears in clocks, meters, motion picture cameras, projectors, and other mechanisms employing thin blank gears, the work is generally provided

with so small a hole that it furnishes an inadequate means of support. An example of this is a gear used in an electric meter, which has a hole only 1/16 in. in diameter. To have this true with the teeth, it is drilled after the teeth are cut.

The principal feature of note here is the quick-removable arbors, shown in Fig. 5, which reduce the loading time to a minimum. The machine is provided with an arbor bracket, in which an extra arbor can be placed for loading, thus saving part of the set-up time. A special holding device is retained in the work spindle slotted to fit the pin located in the shank of the work arbor, and operated by a foot treadle, ejector mechanism, and spring. The latter holds the arbor in the work spindle when the teeth are being cut. The cutter used for finishing the teeth is a combined gear tooth and topping cutter, so that in addition to cutting the teeth it also machines the outside diameter.

A slightly different arrangement is shown in Fig. 6. Here the gear blank, which is used in a motion picture camera, is provided with one central hole and three equally spaced holes nearer the rim. As all four holes are punched at the same setting, there is no advantage in using the central hole for locating purposes.

The arrangement in this case is especially interesting because of the quick operating features involved. The machine is provided with stub arbor which aligns and drives the removable work-holding fixture. The work is not clamped on this fixture but is under pressure when the teeth are being cut through the spring actuated arbor

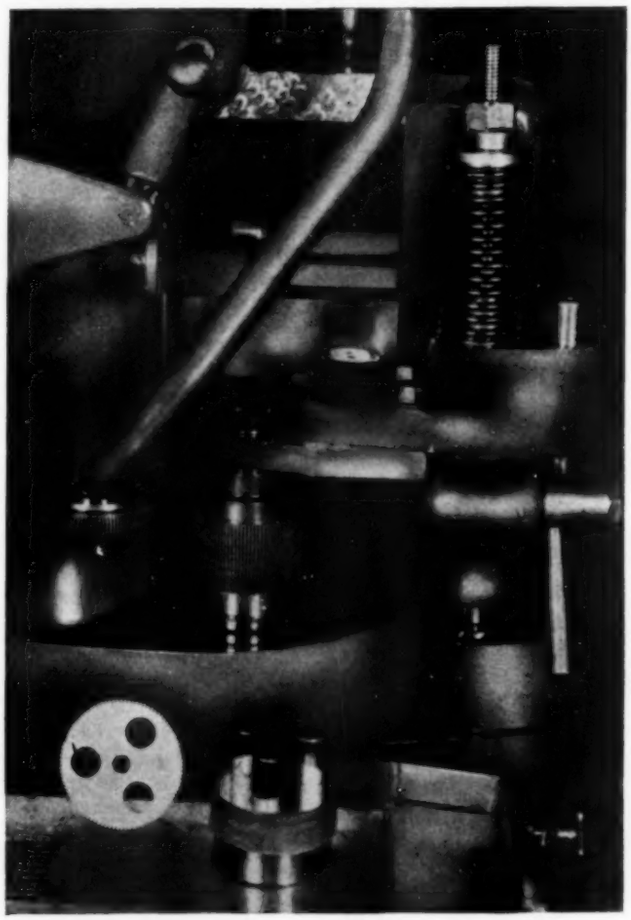


Fig. 6—By making the work-holding device with three pins, the blanks require no clamping other than spring pressure

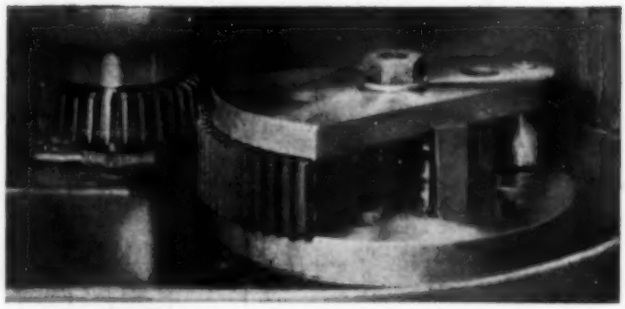


Fig. 7—This fixture is arranged for four stations, each of which accommodates two segments

support. A ball thrust bearing is interposed between the plate on the fixture and the arbor support, so that the work-holding fixture can rotate freely and still have pressure exerted upon the work. A ball bearing is also used on the arbor support between the spring and nut so the arm can be raised and rotated easily to remove and insert the work-holding fixture.

The segment shown in Fig. 7 is used in a washing machine, and the toothed section covers approximately one-quarter of a circle. Several methods could be employed on the gear shaper for cutting the teeth in this segment. One method would be to cut one segment at a time and use a reversing attachment. The other, which in this case was adopted, is to use a multiple-station fixture so that cutting is practically continuous. The fixture is arranged to cut two segments at one setting. When the work spindle indexes around to complete the segments, the machine stops automatically and the operator removes the work, placing the uncut work on the next station nearest the cutter in the direction of rotation of the fixture, so there is no lost time except that required to change the work. In this particular case, the segment, which is made from a forging, is completed in a single cut Four stations are used successively.

Since it works on the reciprocating principle similar to an ordinary crank shaper, the gear shaper can be adapted to shaping or slotting operations simply by the addition of special fixtures. The part being machined in Fig. 8 is a collar for a synchro-mesh transmission, and the operation is the shaping of six equally spaced V-slots. Prior to this shaping, the work is machined by drilling three equally spaced holes and milling three longitudinal slots.

The fixture used for this purpose is of comparatively simple design and replaces the regular apron pan. The tool used for slotting is similar in design to a forming tool used on a screw machine and can be sharpened without any change in form. A special cutter spindle is necessary to hold this tool which is presented to the work at the desired clearance angle. This special spindle is provided with an angular slot of the same shape as the tool and a segment clamping block for holding the cutter.

The work is clamped between collars, the front one of which is slotted to facilitate its removal. The arbor is geared to an indexing shaft. An indexing sleeve, attached to the arbor is located by a spring actuated plunger which can be withdrawn for indexing by a handle provided with a pinion meshing with rack teeth in the locking plunger. For the first operation, the work is located by swinging the locating arm which is provided with a hardened and ground plug fitting the milled slot in the work. The cutting tool is fed to the desired depth by the regular feed cam. When the machine stops, the operator withdraws the locking plunger, rotates the index-

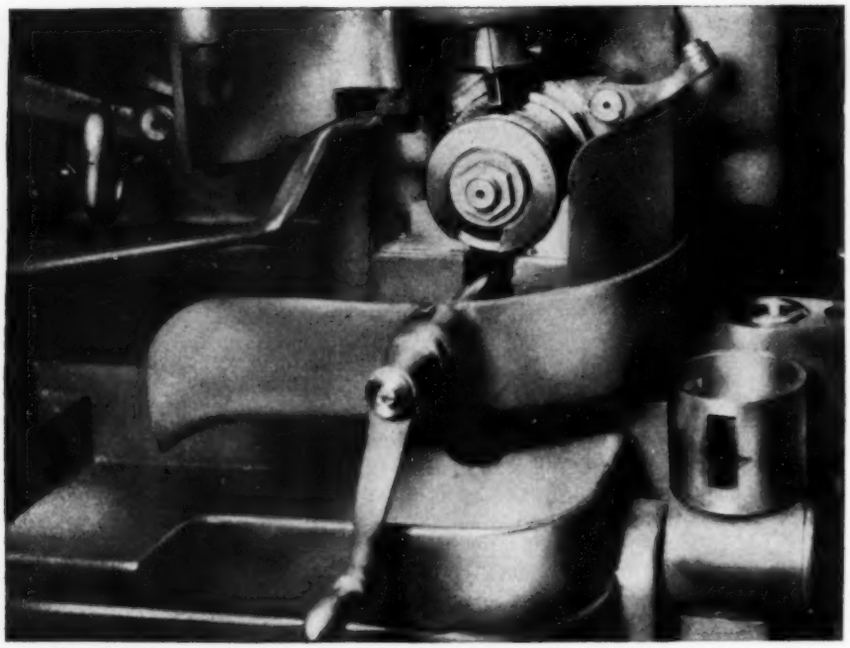
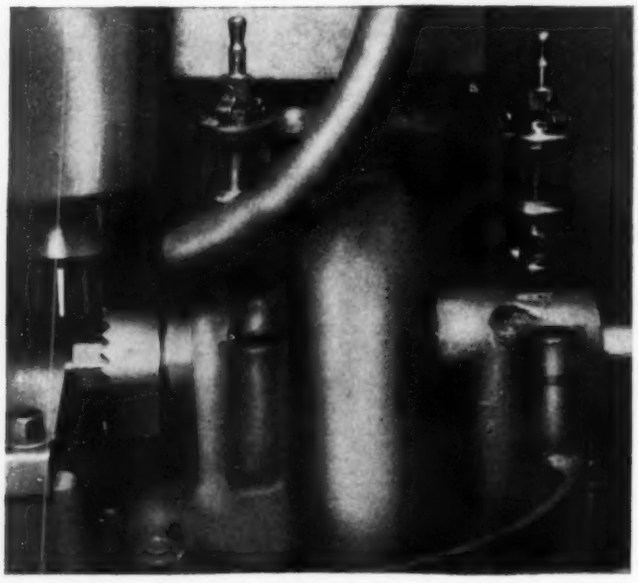


Fig. 8—The work is held in an arbor, geared to an indexing shaft and crank arm, and is located by a swinging set stop

Fig. 9—Face gears may be cut with either spur or helical teeth; even skew gears can be provided so that offset drives, such as are used in textile spinning frames can be made successfully



ing shaft one revolution at the same time releasing lever so the plunger will lock the arbor in the desired position. This operation is repeated until the three V-slots are finished on one side. The work is then removed from the arbor, reversed, and reclamped, and the other sides of the three V-slots machined. With this arrangement it is possible to machine the V-slots to very close limits of accuracy. The vertical setting of the tool is retained in the same relative position after being sharpened by an adjustable screw in the cutter-spindle.

So-called face gears can be cut on the gear shaper by the use of a special fixture, as illustrated in Fig. 9. The work-holding arbor, instead of being located parallel to the cutter spindle, is presented at right angles to it. This horizontal work spindle is driven from the regular work spindle by a pinion attached to the latter and meshing with a face gear held on the auxiliary horizontal work spindle. The fixture is of comparatively simple design, but is more or less limited in range.

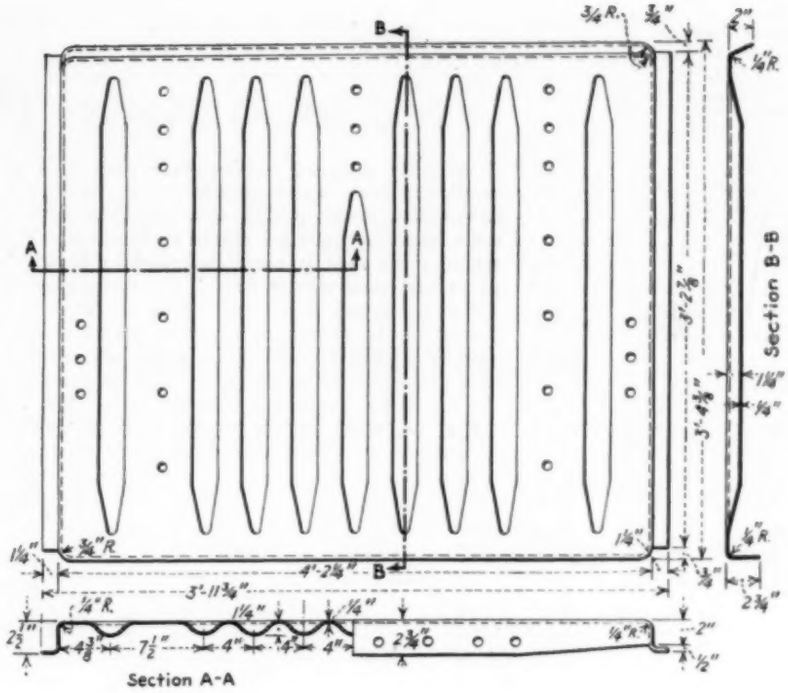
Face gears cut in this manner have many interesting applications. They can be used as positive clutches or for angular drives. Furthermore, a shaft may be divided and the two sections driven in opposite directions. The face gears can be rocked on the pinions and the shafts on which they are held located at different angular relations.

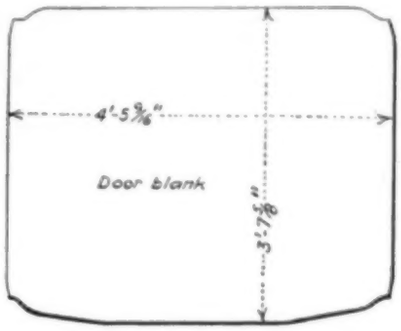
Other special fixtures may be devised for cutting small racks such as those used on weighing scales. These are made to replace the regular apron pan, and are driven by a pinion on the work-spindle which meshes with a master rack attached to the slide that carries the work. As the work-spindle rotates in step with the cutter-spindle, it drives this master rack through the medium of the pinion previously mentioned and thus advances the slide carrying the work. The range of a fixture of this nature is for obvious reasons limited in its application, requiring generally a special fixture for every job.

Preparing Metals for Machining
Discussion

DONALD RAEBURN
Glasgow, Scotland

THE author of the article (*AM*—Vol. 74, page 422) objects to the use of superhard tools to cut through the scale and states that no shop superintendent should accept castings or forgings with abnormal scale, or if not of good machinable quality. But when we remember that a few castings and forgings that are difficult to machine do come to the shops, pieces cannot be rejected without delaying the work. It is often found that after the outer surface of some of these castings and forgings has been removed they are of good machinable quality, although the removal of the outer surface may have been performed with difficulty. The use of superhard tools under these circumstances is surely advisable as an economy of time. We rough- and finish-machined heavy, longitudinal ribbed steel castings of 36-in. diameter with tipped tools of a high quality high-speed steel. The operations included slotting and planing on interrupted surfaces. No breakage occurred, and the tools were returned to stores in good condition.





The finished corrugated hopper car door and the blank from which it is hot-pressed in a single operation. The three different types of flanges are unusual, and the "Z" type flange has not previously been applied to this type of door. The peculiar corner shape of the blank is required to gain the desired flange dimensions

Fabricating

An Unusual Hopper Car Door

WILLIAM J. TANGERMAN
Shop Superintendent, Union Metal Products Company

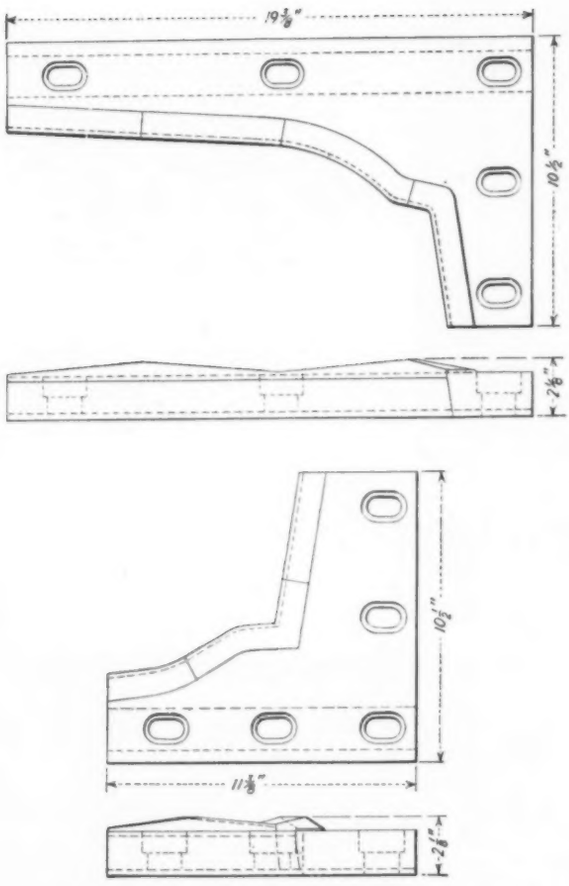
A CORRUGATED drop door for a dump-type gondola railway car which we manufactured recently had some features not usually encountered in this class of work. Three different types of flanges, instead of the usual 90-deg. flanges, were incorporated. The front flange, as can be seen, was straight, the back flange was sloping, and the side flanges were of the "Z" type, used on this door for the first time. All flanges and the corrugations in the door was pressed hot in one operation in a blank 4 ft. $5\frac{9}{16}$ in. x 3 ft. $7\frac{5}{8}$ in. of $\frac{1}{4}$ in. mild steel.

Operations, in order, are: shear, blank, heat and hot press, flange punch, multiple punch, and straighten. The difficult job was the development of the blank on the corners so that the "Z" side flanges, as can be seen from Fig. 1, would terminate within $\frac{3}{4}$ in. from the front and back, while maintaining a $\frac{3}{4}$-in. radius at the corners. Ordinarily, the blank would have a $4\frac{1}{2}$-in. radius at the corner, but the special "Z" flange required an entirely different arrangement. The blanking knives illustrated were developed to make the blank, and worked so successfully that there were no rejections on the entire run of 4,000 doors.

In construction, plates are trimmed to size on three sides on an ordinary shear, the corners then being blanked on a gap press as indicated. The blanking dies were built up, the knives being of tool steel set on semi-steel cast bolsters.

Pressing was done on a 2,000-ton hydraulic press, although only 1,400 tons were required. The first forming operation was the flanging as the dies came together. The last inch of the die stroke produced the corrugations and the top of the "Z" flange. The pressing dies are built up principally of nickel semi-steel parts and wear plates in a semi-steel bolster.

In preparation for pressing, the sheets were stacked on a carriage accessible to a Shepard hoist, magnet equipped, which set them singly on the entering end of a 32-burner gas furnace, 25 ft. long. The plates passed through in four cycles of operation, taking $2\frac{1}{2}$ min., the furnace being of the continuous type. Heated plates were advanced to the press by an electric push-on rig, and positioned by air-operated gaging jacks at the sides and end of the die. An electric pull-off rig removed the finished piece from the die and dropped it at the first stage of a cooling bed. This bed, operating on four stages by means of an air cylinder, has a stacking arrangement at its end whereby the plates are stacked automatically in preparation for removal to the straightening and multiple punching machine. The speed of the hydraulic press and all operations connected with it is 120 plates per hour, but actual



Tool steel coping knives of unusual shape, required to attain the proper blank shape at the corners

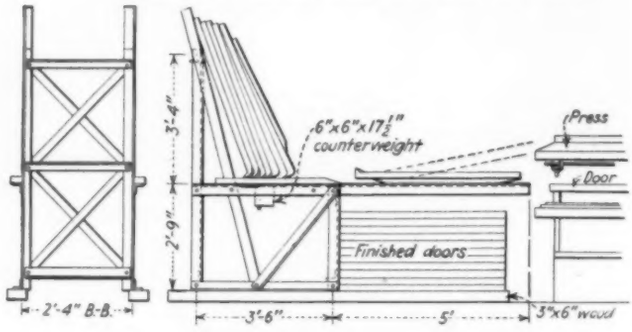
production was 740 doors per 9-hour day, since the furnace could not heat plates fast enough. Four men operate the complete unit, while two additional men aid in stacking the finished doors.

Fabricating requires two operations, the first multiple punching of the holes in the front flange, done in a horizontal multiple punch attachment in one operation. A total of 84,400 lb. of doors are multiple-punched by two men in nine hours. It is possible to do this operation at a rate of 3 plates a minute, but the men cannot stand the pace.

The entire group of $\frac{11}{16}$-in. holes, 25 in number, on the face of the 3x4 ft. door are punched simultaneously on a gap press at a rate of a door a minute. The press in itself is worthy of note. Built by the Beatty Machine & Manufacturing Company, it has a capacity of 350 tons and a throat almost 4 ft. deep. The ram face is 42x42 in., the table face 38x38 in. Ram stroke is variable from $2\frac{1}{2}$ to 5 in., the latter stroke being used in this operation. Rate of operation may be as high as 28 controlled strokes per minute. Ease of handling is attained by mounting the doors on a rack that holds ten doors and is equipped with a trip table. With such means of handling only two men are necessary for the operation, and they produce 540 finished doors per 9-hour day, even though each plate weighs approximately 165 lb.

One decided advantage of multiple punching on work of this kind is that no layout work is required, since the individual punches and dies may be set up to suit a master templet and the plates then simply punched to gage.

A specially designed hopper door rack used to handle the doors at the multiple punch. Doors can be handled more quickly this way than with a hoist, and there are no chains to interfere. The table of the rack is counterbalanced to permit it to be horizontal when a door is slid down upon it, but to tip up out of the way as soon as the door is placed on the punch. Thus doors can be stacked directly under the projecting arms, and removed in stacks of ten by bridge crane. The flanged doors are received at the punch in stacks of ten also, and set at an angle by the crane, to permit single removal by sliding them down onto the arms



Straightening is required in some cases. This is done on a "vertical bulldozer," a special machine similar to a vertical press. The 3-point pressure system is used, the doors being supported on four corners on the bottom dies, the upper die carrying ten jackscrews $1\frac{1}{2}$ in. in diameter, adjusted for proper pressure to remove the buckles. It is only necessary to adjust this die for the first few doors, since the buckles due to shrinkage occur uniformly on all plates. Five men handle this operation, straightening 450 doors per 9-hour day.

Standard Sizes for Catalogs and Data Sheets—*Discussion*

KOCH & KIENZLE

Doctors of Engineering, Berlin, Germany

REFERRING to the article under the title given above, by Warren F. Manthei (*AM*—Vol. 74, page 42), it is evident that the author favors universal standard sizes for catalogs and tables. He proposes as the standard size for data sheets, 8½x11 in. (214x280 mm.), which size approximates the size known as quarto.

For the past ten years, steps have been taken in Switzerland to establish standard sizes for envelopes, books, and magazines, which sizes have been arrived at through commonly applicable fundamentals. Included in these standards is the size A4 = 210x297 mm., which lies in the neighborhood of the size proposed by Mr. Manthei. Would it not be advisable to recommend both sizes, so that the engineer can arrange to file catalogs and leaflets from foreign countries, as well as those of his own? As further sizes, there are proposed the following: A5 = 148x210 mm. and A6 = 105x148 mm. (international post cards).

Originating Precision Templets

WALTER WELLS
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IN THE manufacture of a high-grade line of dies, templet origination requires precision methods to obtain the necessary accuracy. This means the abandonment of the freehand filing method, and the substitution of hardened filing jigs, ground to the proper diameters, angles and tangents. In other words, all arcs must be truly circular, the tangents matching perfectly, the angles correct to 0 deg. —0.5 min., sharp corners not undercut, center-distances not doubtful, and parallel projections or indentations centralized properly. When symmetrical, they must be interchangeable in all respects; in short, they must be geometrically correct.

In this article I describe the making of two such templets, which are of such shape that one might say that their making provides the necessary basis for the making of any kind of precision die templet. These templets were used for some trimming dies made of non-changeable steel and the parts blanked were used in the assembly of a delicate and expensive mechanism.

Fig. 1 shows the dimensions and form of one of the templets. The jig for this is made up of two different sized sets of arbors and collars, each to correspond with one of the radii of the templet. The method of making one of these sets is indicated in Fig. 2. A piece of drill-rod is inserted in the collet of a bench-lathe and drilled out carefully with a 0.125-in. drill to a depth sufficient for a collar $\frac{3}{16}$ in. wide. Then a cut is taken over the stock leaving a grinding allowance for a finished diameter of 0.400 in. The collar is then parted off to its proper width. B is the collar.

Next, the arbor is roughed out, leaving stock to grind on the arbor shank proper *C*, as well as on the shoulder. The cut to part off the arbor to the same width as the collar is not completed. Just enough stock is left to permit the arbor to be cracked off after grinding. The second set is made up in the same manner and then all four parts are hardened and slightly drawn.

Replacing the drill rod in the collet, we proceed to grind the shank so that the collar will fit without a shake and be tight enough so that the combination can be ground over the outside, all in the one setting. It then can be broken off at *D*, the rod having been hardened right up to stub.

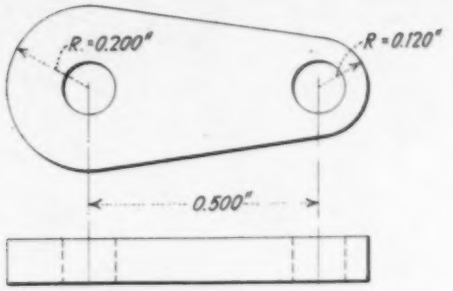


Fig. 1

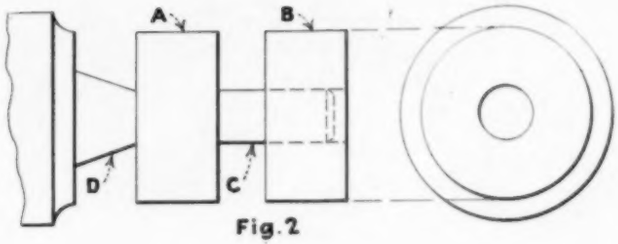


Fig. 2

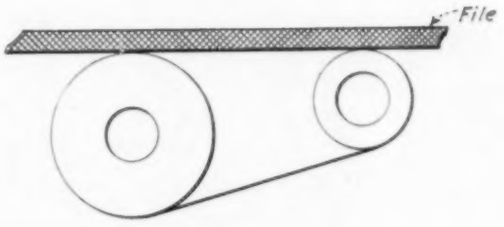
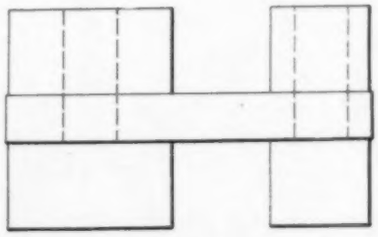


Fig. 3



Figs. 1, 2, 3—Four disks, two corresponding to each radius, enable a mechanic to file interchangeable and reversible parts quickly

The flat templet material was then laid out approximately, but the two holes were drilled the exact center-distance apart, 0.500 in., using a very small combination center-drill and a 0.500-in. spacing block to assure the exact location. This trick is probably known to American tool and diemakers. No center-punch marks are used. A piece of flat stock having a straight edge is clamped on the table of the drill-press in such a position that the templet stock is nested up against it when spotting the farthest hole. For convenience, the center-line

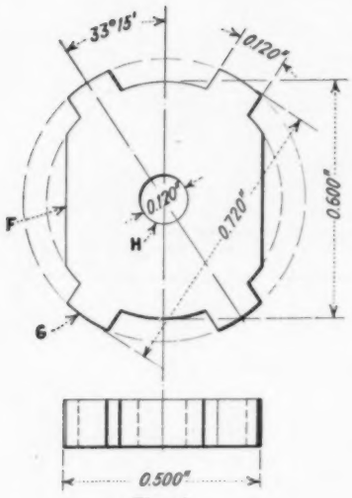


Fig. 4

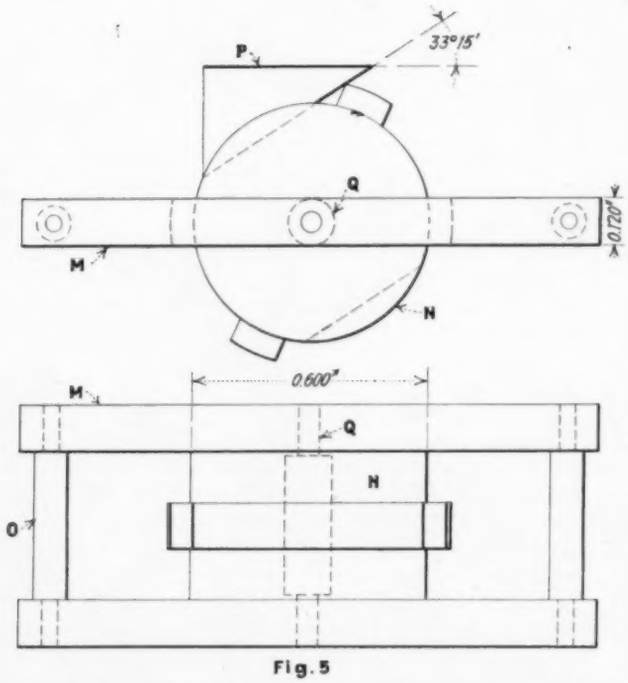


Fig. 5

Figs. 4 and 5—A complicated templet that can be filed in 1 hour after the protecting parts are made

of the two holes in the templet is laid out at right angles to the side of the stock. Then the spacing block is introduced between the bar and the templet stock for spotting the second hole. The 0.125-in. holes can be drilled freehand. Necessarily, a toolmaker's experienced touch is required for this, but it is a short-cut way of locating holes accurately in thin material.

The holes being checked and the templet rough-filled, the two sets of jigs can be clamped on, the assembly being shown in Fig. 3. A good way to clamp on the jigs is with a pair of small "C"-clamps. After having cleared away most of the stock with a No. 1 file, we can remove the clamps altogether and just hold the set-up between the fingers while finishing up with a No. 4 flat file. The two flats are obtained by bridging over both the jigs as at Fig. 3. When no more stock can be taken off, the templet is down to correct dimensions.

The other templet shown at Fig. 4 is even more interesting to make. It has contours running on two circles, two parallel flats and four projections extending symmetrically on a precise angle. It is first laid out, drilled to exactly 0.121 in. and finish-turned to a 0.720-in. diameter, using a stud-arbor for the latter operation. Then the two flats *F* are rough-filed and subsequently finished by grinding them parallel and equi-distant from center, the over-all dimension being 0.500 in. When the remainder of the outline is rough-filed we are ready to make the filing jig.

The jig, Fig. 5, is composed of a frame, two disks and a shaft. The frame comprises the hardened strips *M* and the shouldered spacing-pins *O*. The shaft *Q* is shouldered to fit both the holes in the frame and the pair of hardened disks *N*.

Two strips of tool steel 1½ in. long are drilled in pairs to accommodate the spacing pins. The fit should be without a shake. Then the center hole for the shaft is drilled as square with the surface as possible, following which the strips are hardened. The diameter of the shoulder on the shaft should be 0.121 in., while in length it should be somewhat shorter than the combined width of the templet stock plus the two disks, that is, not more than $1\frac{1}{32}$ in.

To grind the frame parallel, it should be laid on a magnetic chuck, in assembly with the shaft (omitting the disks). Shim it up on one side, if necessary to get it cutting even, until the wheel leaves a tell-tale mark on the shaft. The shaft's diameter being left purposely 0.001 in. oversize relative to the strips. Turn over and do the same. The strips should finish to 0.120 in., the same width as the projections on the templet.

The disks are also made of ⅛-in. stock. The holes are 0.121 in. and the O.D. are ground to 0.600 in. to correspond with the inner circular outline of the templet. An auxiliary piece is now ground to the correct angle, a Johansen angle test block being used to get the necessary 33 deg. 15 min. The width of this piece is made just 0.0005 in. thicker than the templet stock so that it will hold in place when pressed against one of the flats on the templet and in between the pair of disks (the whole assembly being now held together with an adequate pair of parallel clamps). The angle piece in position is shown at *P*, Fig. 5.

To get the projections to their correct angle, the frame, disks, templet and angle piece being assembled, we block up the frame on a pair of parallel bars and bring the flat of the templet with the angle-piece adjacent to it around so that the upper edge of the angle-piece can be leveled off with a surface gage and indicator. Finally, the clamps should be tightened. The angle can be nothing else than correct and need not be checked afterward.

The entire outline of the templet can now be finish-filed flush against the hardened edges of the jig, all save immediately around the two projections that are not protected in this setting. The filing is completed by resetting the angle piece in the reverse position, that is, by protecting and filing around the remaining opposite two projections. It may be remarked that the making of the jig was an 8-hr. job, the filing, 1 hr. An incidental templet filed by a qualified gagemaker took 17 hr. and was finally rejected by inspection as not quite close enough on the angles and interchangeability.

It is evident that this method can be used for making small quantities of accurate parts, or for filing a single accurate surface.

The Tool and Equipment Supervisor, His Organization

JOHN C. DENSE
Tool Engineer, Delco Appliance Corporation

NEXT to ordering tools, comes the proper storage and caring for them. The first matter to be determined is the manner of designating these tools by number or letters so that they may be cataloged.

This is ordinarily the same as the tool drawing number, that is to say, the tool drawing and the tool bear the same designation. This may be a number such as T-1,000, the letter "T" covering all tools, or it may be listed as J-1,000, meaning a jig, D-1,000, meaning a die, and so on. If preferred it may be a symbol which is so arranged that is gives a lead to the type, size and general characteristics of the tool. Several of these systems are in use.

It is the writer's opinion that all tools, such as jigs, fixtures, dies, and special cutting tools should be classified under this tool number alone, and not under the number of the part they are used on as this avoids the endless confusion of changing and adding or removing part numbers from files in the tool vault. The operation sheet should be the authority for establishing the connection between the tool and the part. The successive tools which are made from a tool drawing, as D-1000 mentioned above, should bear a designating character such as D-1000-A, D-1000-B, etc., so that a separate record may be kept of the performance of each tool.

The card shown at Fig. 21 contains space for the record necessary for the tool vault keeper. There should be one of these cards in the file for each tool. A complete history of the tool should be kept until it is finally worn out and marked off as scrapped. It should not be replaced by a tool bearing the same symbol, as this would confuse the records.

If there is one section set aside in the tool vault for each kind of tool, such as jigs, fixtures, dies, automatic screw machine tools, molds, etc., and these sections all arranged numerically, there will be no confusion in finding the proper tools and delivering them without loss of time.

Should one of the tools become obsolete, the tool drawing should be so marked and a notice to that effect sent to the tool control chief, who will have it removed, and placed in a section reserved for this purpose, to be gone over later and parts salvaged or scrapped as may be thought best.

The general scheme of tool control calls for a main storage vault and a number of tool cribs so arranged as to best serve the several departments. These cribs should be manned by men trained in this work—men who have a fair knowledge of tools, at least a grammar school education and a liking for their work.

These men will preferably be trained in the main tool vault, so that they may become acquainted with the many types of tools and thus be available for use in any one of the tool cribs.

The special tools may be handled either through the tools cribs in the departments or through the main tool vault, as thought best, preferably through the tool cribs as they are more accessible to the departments.

The special tools will be drawn out of the crib upon presentation of the special tool order blank, shown in Fig. 22, by a messenger from the foreman requiring the tool and will be charged out to this department.

The standard small tools, such as drills, reamers, taps, etc., will be stocked in each crib and may be drawn out by the operators and charged to them by check number, or any other of the many methods in vogue. The brass check system is as simple and effective as any. It limits the number of tools any man can have out at one time and does not require bookkeeping.

A standard card file should be maintained in the tool control chief's office, showing the quantities of new small tools in stock at the end of each day, this is to be kept up by records of disbursements of tools from the tool vault to the cribs.

The tool control chief assumes responsibility for the special tool from the time it is designed until it worn out.

He is not responsible for the making of the tools, or for the upkeep of them, but is entirely responsible for their appearance at the right time and in sufficient quantities.

His department, through the medium of the tool detention crib, which was described in connection with the tool department, keeps a performance record of each tool, the number of pieces produced between the times it comes in for repairs, the cause and date of repairs and date it is put back into commission.

The responsibility of keeping the shop supplied with special and the so called standard types of tools is no small one, testing the various makes of drills, taps, reamers, etc., determining the ones most satisfactory, and stocking these tools in places accessible to the manufacturing department make a real man-sized job and one requiring a lot of thought and technical experience.

The general foreman of the tool department will be the next position to be analyzed, and the duties and processes of this department will be the subject of this section.

The work involved in this department is of great

exactness and precision and requires a man with a wide knowledge of tooling in its many forms, a fine mechanic, and a supervisor of more than average ability, because he deals almost entirely with men of high technical ability, who require more skillful handling than the average shop man. The organization of the tool department is important and should be so arranged as to give the best service to all the manufacturing departments of the factory with the least delay.

It is the writer's belief, based on many years of active tool work, that the tool department, if of sufficient size to warrant, should be divided into two sections, namely, new tool manufacture and tool repairs and upkeep.

These two classes of work do not have much in common and will cause interference and delay if carried on together.

It may be argued by some that there is an advantage in having the man who built a certain tool or set of tools service these same tools; but the fact remains that the advantage gained is more than offset by the trouble caused by this intermingling of these two classes of work. New work will always suffer by the intermingling of repair work, the latter usually being work requiring instant attention, and breaking into the routine of new work. Toolmakers as a rule do not like repair work, when new work is available.

Anyone who handles new tool work and tool repairs in the manner suggested here, will find as the system develops that men become so expert at repair work that they will far outshine the men who build new tools. This is, of course, because their training in this class of work really makes them specialists. They develop short cuts and systems of making repairs to the tools they are familiar with which are invaluable.

In order to produce the most work in the least time the tool department should be further subdivided into groups, each with a leading man. These groups are the bench men, who are all around tool makers, the lathe men, the shaper men, the milling machine men, the grinder men, the drill press men, etc.

The work to be done is handed out to the bench head by the foreman, or his assistant, if the size of the department warrants an assistant, together with the material necessary for making the tools. The bench man after studying the job carefully, proceeds to farm the parts out to the machine gang leaders for fabrication.

The foreman or his assistant in addition to their duties of supervision, will also be called upon to give estimates on work coming into the department, if the system in vogue calls for an estimate before the work is started.

This estimate should include cost, and date of delivery. If accurately done it will comprise no small part of the work expected from these two men.

We will next discuss the methods to be followed in routing new tools through the tool room. The new tool work is received into the tool room direct from the tool control office, the work orders and blueprints being sent direct and the necessary material coming from the stores department after having been ordered out by the tool control office.

The different grades of material should have a symbol or specification number stamped upon them when leaving the store's stock department, and a ruling should be made and held to strictly that anyone machining this number off must see that it is replaced.

The identification number used is dependent upon the method used when purchasing steels, if purchased under specified analysis, the specification number should be used. If purchased by the trade name under which most tool and high speed steels are marketed, a symbol representing the trade name will be used.

Which of these two systems are used is largely a matter of policy, but it seems probable that greater accuracy can be maintained in the hardening of steels when the exact analysis is known.

The shop order, blueprints and material having been

SPECIAL TOOL DISBURSEMENT CARD — T. NO. 19175

LOCATION SEC.	LOCATION SHELF	TO GRIND NO.	DATE	RET'D TO VAULT O.K. DATE	REMARKS
E	4	5	2-6-29	2-15-29	
E	4	5	4-9-29	4-17-29	Perforator broken-repaired.
E	4	5	6-7-29		

Fig. 21

delivered to the tool room and ready to pass out to the tool makers, and the following course is suggested:

After the work has been gone over by the foreman of the tool department and methods to be followed in manufacturing have been discussed, the work is ready to hand out to the leader of the bench men. He in turn, hands it to the bench man he has picked for the assembly job, together with any instructions he may have.

After going over the job thoroughly, the bench man proceeds to hand the material to the leaders of the several machine groups together with sections of blueprints which he has cut up for this purpose.

As the jobs of machine work are finished the parts are handed back to the bench man who gave them out. He, in turn, does whatever bench work is necessary and after seeing that everything is O.K., each part properly marked, etc., sends them on to the tool hardening department, if hardening is called for. After whatever finishing work is required, the job is passed back to the leader of the bench group, who after inspecting the workmanship, has the tool room clerk check it to the tool inspection department.

It is desirable that provision be made for a tryout of completed tools before delivering them to tool inspection.

This may not always be possible because of the type of the machine tool involved, but can usually be done in the case of the more frequently used machine tools, such as punch presses, drill presses, etc.

If these last mentioned machines can be provided in the tool department, the tools may be sent to the tool inspection department with samples of the work attached, which should, in most cases, be sufficient guarantee that the tool is right.

In discussing the matter of handling work into and out of the tool repair section of the tool department, the question arises as to who is going to determine when a tool needs to be sent to this department and who will authorize it done. An efficient method is outlined here,

which involves the use of a man, or men, as the situation may require, who may be called floor tool inspectors. The duties of these men will be to pass upon tools in use and when the product becomes unfit for use or when for any reason the tool is not performing properly, they shall have the tool removed from the machine and after attaching a tool repair tag, such as shown in Fig. 23, have it sent to the tool detention crib.

This detention crib is deserving of mention here, as it is the medium whereby records are kept of the performance of each individual tool. It is operated thus: The tool, upon failing, is tagged by the tool inspector, the tag being made out to describe as nearly as can be determined at the time just what is wrong with the tool. The tool is then sent to the detention crib where it is received by the crib attendant; the information on the tag is transferred to the file card, together with the date of entry. The file card is shown at Fig. 32. The stub is then torn from the tag and sent to the foreman of the tool department. It passes from him to the foreman of the tool repair department and from him in turn, to the tool repair man who is going to work on this particular tool. This tool repair man presents the stub at the tool detention crib and gets the tool.

Upon the completion of the repair work, the tool, together with the stub, is returned to the tool detention crib, where the record of the completion of work is made on the file card and the tool returned to the tool vault to be put back into production when called for

The value of the record kept in the tool detention crib lies not alone in the value it has in keeping track of the tool for tool room purposes, but if properly kept and ocasionally gone over by someone interested in the tool development work, it has a value in that it shows up the weaknesses of the different tools. In plain language, it shows up the number of times the tool in question has been in and what was the trouble with it each time, and it becomes a simple matter of analysis to determine what steps should be taken to strengthen the tool in question so as to alleviate these weaknesses.

It can be further shown just how many pieces this tool made between repairs, by having the inspector who tags the tool add to his information the number of parts completed. This will give a thorough and convincing life history of the tool to anyone interested, be he production man, tool development man or metallurgist seeking information as to the best steels for use in dies, etc., as the records also show the amount of production between grinds.

New work leaving the tool inspection department should also pass through this tool detention crib, and a record made showing when the tool went into production.

SPECIAL TOOL REQUISITION.

NAME OF TOOL *Perforating Die*	T. NO. *19175*
NO. REQ. *1*	DATE. *2-6-29*
DEPT. NO. *5*	
FOREMANS SIGNATURE *W. J. Brown*	

Fig. 22

These precautions for keeping accurate performance records of production tools will make a good return on the investment if accurately kept, as in this way tools that give exceptional performance may be adopted as standard, without any guess work.

The tool detention crib is primarily under the supervision of the tool control chief, the same as the other cribs, but the information is open to the whole tool and equipment supervisor's department.

It is difficult to do justice to the position of the foreman of the tool department in a brief discussion like this, as anyone who has had the experience of standing in his shoes will realize, because the sources of his greatest annoyances and the things that call for the greatest show of judgment are seemingly insignificant and often unexpected. Unexpected engineering changes, necessitating rush changes in tooling, which must, however, be delivered on time just the same, and numerous kindred causes, keep him constantly on the alert.

The foreman of the tool department needs a good system to assist him and take the burden of remembering promises of delivery off his mind and leave him free for the technical matters that demand his attention. This system can be very simple, just a card file with the jobs filed under the delivery date, by the clerk and the jobs brought to the foreman's attention at some predetermined time previous to the delivery date.

The tool hardening division may be under the general foreman of the tool department or, as is sometimes found, under the metallurgical department, and will function well in either place with the proper man in charge of it.

The hardening of high speed, carbon and alloy steels is a highly technical job and requires a knowledge of the construction and composition of steels, together with a practical knowledge of the uses and abuses of these same steels when fabricated into tools of various kinds.

A record should be kept in the tool hardening department of the treatment given a certain tool if this varies in any way from the standard treatment usually given this particular steel. This special treatment can then be followed up through the records in the detention crib and any question of the performance of the tool can be quickly settled.

One of the conclusions evident to anyone who has been in touch with the tool and equipment supervisor's work is the fact that he must be able to keep absolute control of the tooling from its inception in the processing department through the tool engineering, tool making, tool control, setup, tryout and maintenance, and in the same way keep control of the machine equipment, its purchase, setup, approval, maintenance and disposal, after it has served its purpose, or possibly has become obsolete through change in design of product.

Unless this control of the tooling situation is maintained in its entirety, the tool and equipment supervisor and the tool engineer lose their contact with the work, and through this loss of contact they lose one of the things most necessary for them to have and that is the privilege of putting all tools of new design into work themselves so that they can observe them carefully and profit by any shortcomings these tools may have. In this manner, progress in design of tools is made. The tool and equipment supervisor cannot depend on anyone else giving him this information, as his department had certain definite things in mind that they wished to accomplish when they designed the tools, and anyone, no matter how competent, cannot say definitely whether the tooling

in question is satisfactory or not unless he has this same viewpoint.

The competent and well organized tool and equipment supervisor's department will function efficiently if organized as outined herein. The assumption of all of the responsibilities will increase the efficiency of the department, as it promotes a well balanced organization that has complete control of the tool and equipment situation and its coordinated systems.

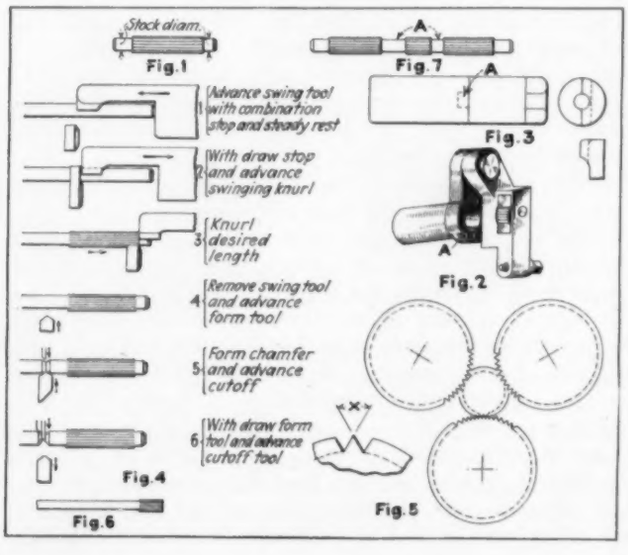
This article concludes a series. Other articles of the group will be found in Vol. 74, pages 855, 909, 945, and Vol. 75, page 17.

Knurling Work of Small Diameter

HAROLD P. BERRY

IN KNURLING work in the automatic screw machine, considerable trouble will be experienced when the length is great in comparison with the diameter, since the work will bend easily. The use of a rest to back up the work will have a tendency to mar the knurling where it contacts with it. When the knurling is done by a tool held in the cross-slide of the machine, even though the stock can be supported in the turret, the length of the knurled section will be very limited.

When the knurling tool is held in the turret and the length of the knurled section approaches the limit of turret travel, an entirely different condition is presented, especially if the machine has but a single spindle. Referring to Fig. 1, it is assumed that the diameter of the stock is $\frac{1}{8}$ in., and that the knurling to be done is not to disturb the diameters at the ends. It will readily be seen that with a standard swing tool, such as is shown in Fig. 2, because of the spring of the work, a satisfactory knurled section will not result unless a rest is provided. Such a rest is shown in Fig. 3, and it may be inserted in the hole *A*, Fig. 2. In this case, the diameter of the hole in the rest should be close to that of the work to insure against spring. However, in starting the tool to knurl in the opposite direction to that indicated by the arrow, the contact of the work in the rest will have a tendency to mar the knurling. When sharp knurling is required, this direction of feed is impractical because of the closeness of fit between the rest and the stock.



The knurling on the pin in Fig. 1 could be produced by using a tool having three knurls set 120 deg. apart, as shown diagrammatically in Fig. 5. The knurling would have to start at the extreme end of the stock, as indicated in Fig. 6, and continue nearly the whole length of the pin. Then it would be necessary to make a turning operation with a box tool to remove the knurling from the front end. This method would require three turret positions; stop, knurl, and turn. Such a method could not be used in knurling the pin shown in Fig. 7 because of the sections *A* from which the knurling would have to be removed, either by a swing recessing tool, or by a cross-slide tool. This method would require considerable experimenting to perfect, depending upon the results desired.

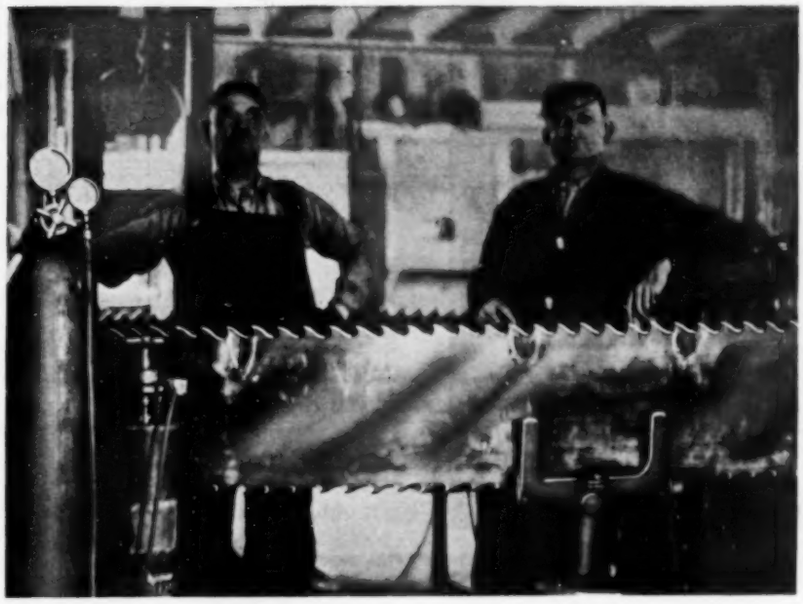
Such a pin as is shown in Fig. 1 can be successfully produced by the use of but one hole in the turret of a B & S automatic, or it can be produced in a machine without a turret, such as a B & S cut-off machine by the method described below. A standard swing knurl-holder fitted with a work rest can be placed in the turret, the turret being arranged for non-indexing, or in the end slide of a plain cut-off machine. The rest should be arranged to permit the stock to be fed against it. It should have a blind hole, as at *A*, Fig. 3, to insure that the stock shall not be forced to one side, or possibly beyond the desired length. The procedure will be self explanatory by reference to positions 1 to 6 in Fig. 4. This method permits of simple operation without loss of time, and permits the rest to be in contact with the stock diameter just preceding the knurling tool, and resulting in excellent knurling.

Because of the method of advancing the knurl and then permitting the tool to drop back, as indicated in positions 2 and 3 in Fig. 4, by reason of spring tension on the machine, it may be found necessary to add an auxiliary spring to prevent the knurls from forming a track in position 2, and prevent the swing tool from being carried back, thus preventing it from performing the desired operation. The pin shown in Fig. 7 can be produced by the operations outlined, and can have as many knurled sections as desired. The lengths of the sections will be governed by the amount of the end-tool travel permitted by the end travel of the slide carrying the tool.

The same methods can be applied to machines having multiple spindles with slightly better production efficiency, but not greatly bettering the single spindle type on such pins as shown in Fig. 1. The use of a multi-spindle machine on the pin shown in Fig. 7 will result in a considerable saving in time, as several separate knurl holders can be used in different positions. The production time will be dependent upon the length of the longest single knurled section. In the single-spindle machine, the knurling tool must be released to take care of each break in the knurled sections.

The resulting condition of the knurling is dependent upon the pressure applied by the knurls, the condition of the knurls, and the angle of their teeth, see *X*, Fig. 5. On brass work, knurls having a tooth angle of 90 deg. will perfom well. On steel, knurls having teeth at such an angle will give results suitable only for roughing and raising the diameter but slightly, depending upon the diameter of the work before knurling. When the knurling on steel is required to be sharp, the angle of the teeth should be less, approaching 75 deg. on work of small diameter.

SAW DENTISTRY



with gas

Practical Points and Procedure for Repairing Large Band and Circular Saws by Welding

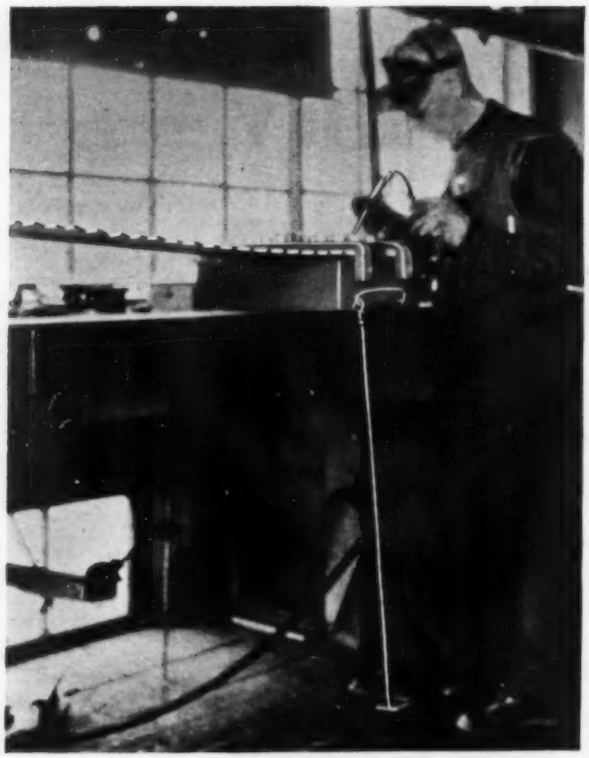
SAWS, particularly heavy circular or hand saws for lumber mills, are now being repaired by welding, either by the arc, atomic-hydrogen, or the oxy-acetylene flame. A page of pictures portrayed methods used in welding with the atomic-hydrogen equipment by the Vance Scales Saw Welding Company (*AM*—page 921, Vol. 73). This discussion will be limited to saw welding with oxy-acetylene equipment.

It should be emphasized that the welding of saws is a highly specialized operation which should not be attempted by a welder until he is thoroughly familiar with the exact procedure to be followed for each type of saw repair. In fact, an oxy-acetylene service operator should be consulted before major saw repairs are attempted. Good steel saws have undergone a very intricate heat-treatment and working of the metal in their manufacture, and this fact must be taken into consideration in welding. Procedure controls for saw welding have been developed, of which only an outline can be given here. This information is derived from the Linde Air Products Company and the California Industrial Accident Commission.

A type of saw clamp best suited to the needs should be provided. This clamp should be constructed to hold the ends of the saw metal firmly in position, and the two center clamping bars should be not more than 6 in. apart. The usual clamp, as used in filing rooms when brazing band saws, is not suitable. Each clamp requires an anvil bar which should be of the quick-operating type. A bar which can be raised to position by a foot lever has proved most satisfactory. The airplane type of torch should always be used, as this type permits a much better control of the flame than does the larger torch. A welding rod best suited to the individual doing the work should be used, but no rod should be used whose diameter is greater than $\frac{1}{8}$ in.

Heat up the anvil bar in the clamp, to prevent sudden chilling of the weld when raising the anvil to forge welds. Place the cracked section of the saw directly over the anvil bar. Adjust clamp bars to hold the saw firmly in position. Cut a V-groove in the crack, either using a diamond-point cold chisel or a portable emery wheel. If a wheel is used, care should be taken not to burn the saw steel. This V-groove should be from $\frac{1}{16}$ to $\frac{1}{8}$-in. wide, depending on the thickness of the saw (a cutting torch must never be used). If the crack being worked on is a gullet or a back crack, the next step is to tack weld a holding piece of saw steel, say a 2x2-in. piece, at the outer end of the crack, being careful not to burn the metal. Apply the heat to the saw beginning at the inner end of the crack, and as soon as the saw material has reached a bright red heat, insert the welding rod, and fuse or weld about $\frac{3}{8}$ of an inch, never more than $\frac{1}{2}$ in. at a time.

In welding, always use the backhand method, that is, point the flame toward the starting point. A neutral flame is found to be the most satisfactory. When $\frac{1}{2}$ in.



Clamp used in making a bandsaw butt weld

has been welded, back off, or remove the flame, raise the anvil bar as quickly as possible, and start forging or hammering this section. Continue to forge until the weld shows the approach of a blue color. The forging of the material, the speed and accuracy with which it is done, has a great deal to do with the success of the weld. Reheating for the purpose of forging does not give results. After forging down this section, see that the remainder of the V-groove is free of all scale, slag or other foreign particles, then proceed as before, welding and forging alternately.

Some filers prefer to build up a broken bandsaw tooth, instead of inserting a new one. To replace a broken tooth, an entire tooth should be cut from a scrap saw, the edges beveled, one end of the tooth tacked to the saw with a gap of $\frac{1}{16}$ in. between saw and tooth; and starting from the opposite end from the tack, the welding is done according to the outlined procedure. A blank may be welded in if preferred. To weld broken circular or round saw teeth the same method is used.

After any weld is completed and all forging is done, the weld should be dressed down, either with a file or a portable emery wheel, then the whole be reheated to a bright yellow color to anneal and distribute stresses which have been set up, and then quenched in oil or water. This makes the weld flexible, but does not add to its strength.

This job is one which requires considerable practice, patience, speed and skill. No filer should attempt to run a saw which he has welded until he has done considerable experimental work. He should spend many hours making butt welds in various widths of test pieces which he has cut from old discarded saws. He should weld these, studying flame, rod, forging, etc., then break them apart and study the results of his efforts. Look for burned material, hard or brittle spots, crystallization of metal, etc. Work these welded pieces over the bench and under the rolls, and try to lay them up as would be done were they actually to be placed on the band mill.

To make a weld across a bandsaw, proceed as before. Place the ends to be welded under the clamping bars, and directly over the anvil bar. Have a gap of $\frac{1}{16}$ to $\frac{1}{8}$ in. between ends of stock to be welded.

The majority of saw welders prefer to start in the center of the job, weld about $\frac{3}{8}$ in. at a time, forge this, then start a new weld, working outward on alternate sides from the center. When working on a headsaw, due to the thickness of the blade, it is a good practice to open up the crack with a hard blunt chisel. This gives better penetration without overheating.

A special clamp should be provided to hold circular saws on the anvil, to prevent buckling or bulging. Probably greater experience and skill is required when welding rims or eye cracks of circular saws than is required to butt-weld band saws. Also more work and skill is required properly to hammer, tension, and lay up a circular saw after doing a large welding job on it than is required on a band saw.

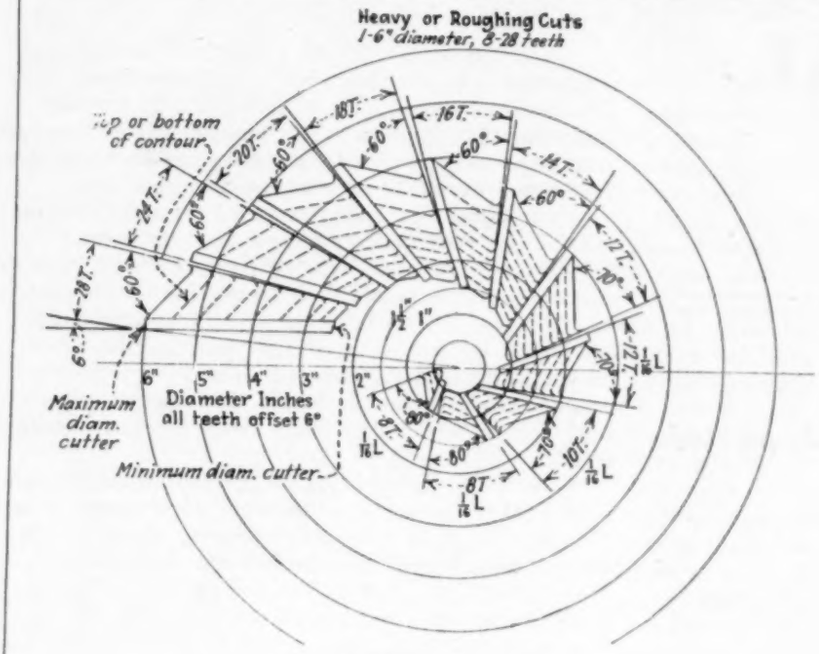
To weld a rim crack, first V-groove the crack the full depth and about $\frac{1}{8}$ in. wide, then start at the inner end and work outward, welding not more than $\frac{1}{2}$ in. at a time. before forge hammering. If the saw is a heavy, thick one, it might be better to grind out the crack, making a straight cut all the way through and about $\frac{1}{8}$ in. wide, instead of V-grooving. This would permit the turning of the saw over on the anvil and working from opposite sides, if or when the saw shows a tendency to buckle excessively. The weld should be made from both sides, working from the inside of the crack toward the rim. As the work proceeds, the buckling is hammered out. When the welding flame is applied the saw will buckle upwards. Weld about $\frac{1}{2}$ in. half way through the metal, then quickly turn the saw over and weld the other half from the other side. Rapidly turn over the saw and hammer down the buckle while the steel cools. Next turn the saw over again and start another spot. This time the saw will buckle the other way. Repeat this procedure until the weld is completed.

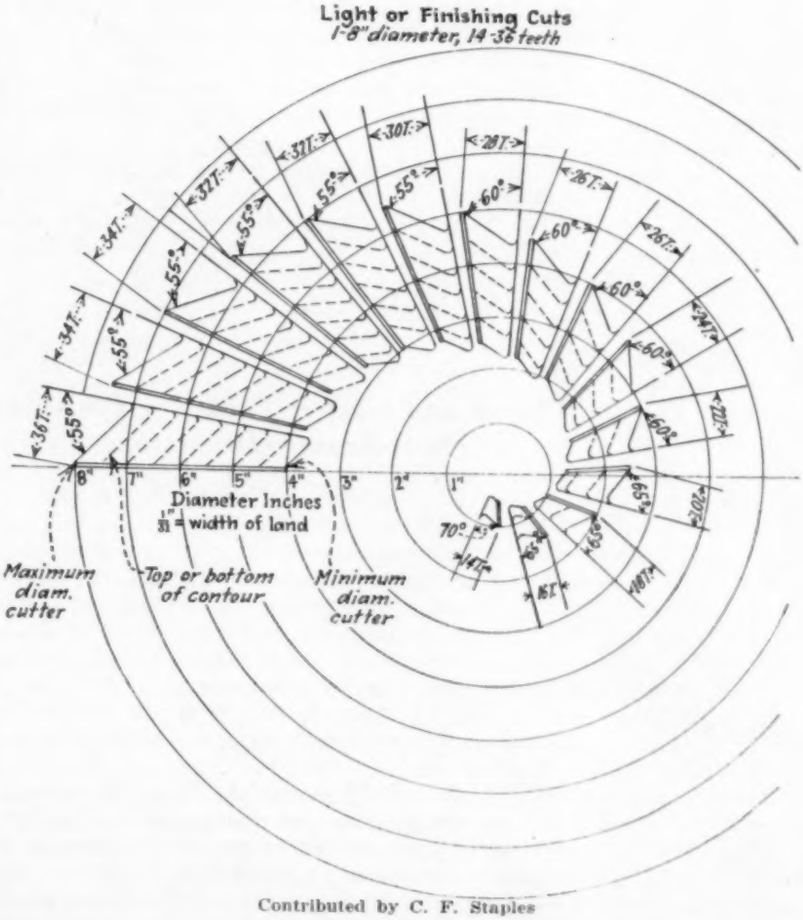
A broken eye is very difficult to weld and special equipment is necessary to handle this work. Therefore, the average saw welder should not attempt this class of work, but should turn it over to someone specially equipped for handling it. Where eye cracks exist, a rectangular piece should be cut from the center of the saw. Then insert a new center piece, this to be about $\frac{1}{4}$ in. smaller in all directions than the piece removed, and proceed to weld and forge. After the weld is completed, hammer the saw level on the anvil, heat to a bright yellow color, retension, and cut the new eye.

Some filers and saw welders do not advocate the cutting out of the damaged section, but prefer to V-groove and weld the crack itself. Probably each method has its merits, and experience will show which method is the better. It is known that commercial saw welders are using both methods, but prefer the former, that is, making an insert.

Saw welding opens new fields as it offers unlimited opportunities for savings in the lumber industry. A point to remember is that a good filer of band saws will get an occasional crack. Filing in such a way as to avoid all cracks does not give the best article, so if the filer knows that occasional cracks can be repaired he will scrape down a finer saw, carrying the tension to the edge, which results in a better job and in cutting more lumber.

MILLING CUTTER SIZING CHARTS


Heavy or Roughing Cuts
1-6" diameter, 8-28 teeth
Top or bottom of contour
Maximum diam. cutter
Diameter Inches all teeth offset 6°
Minimum diam. cutter



Contributed by C. F. Staples

THESE charts are designed to aid in determining how a cutter tooth will appear without going through the preliminary cut and try lay-out method. They should be laid out to scale. If drawn on a separate sheet, they may be slid under a tracing and the desired diameter and contour may be traced, thus giving a rapid means of determining the exact layout.

Fig. 1 is a chart for heavy or roughing cutters, from 1-6 in. diameter, and from 8-28 teeth. Opposite each tooth is the gashing angle, number of teeth and the land. For example: By following the 4-in. diameter line it will be found that this cutter would have 16 teeth and would be gashed with a 60-deg. cutter; also that the depth of contour extends to the 1½-in. diameter, thus giving 1¼-in. maximum form. Fig. 2 is for light or finishing cutters from 1-8 in. in diameter with from 14 to 36 teeth. The only difference between the charts is that the roughing cutter in Fig. 1 has a 6-deg. hook tooth and Fig. 2 shows straight radial-tooth cutters.

These charts are suggested as an aid in laying out cutters and not as a definite rule to be followed, as different jobs present different problems, and in each case the cutter should be designed to suit, these charts to be used only as a starting point.

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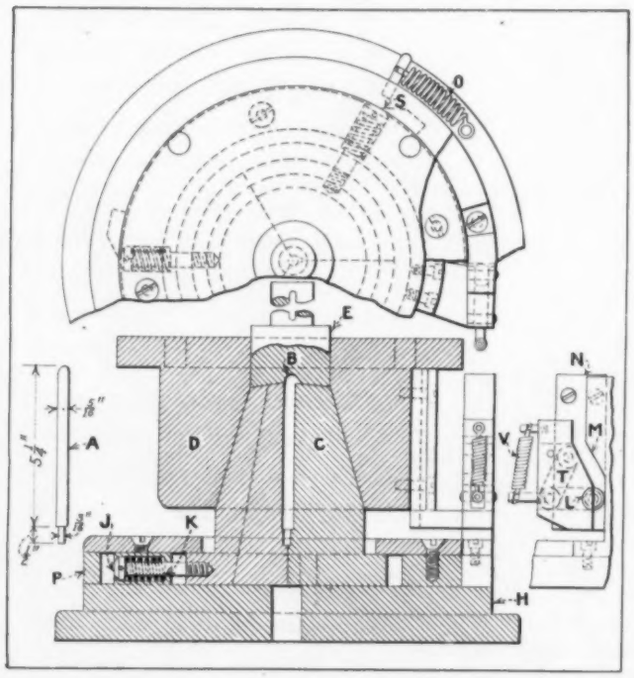
Ideas from PRACTICAL MEN

Press Tools for Forming Heads on Rods

ROBERT R. CORNELL

We had a large quantity of hard-drawn rods of 15 per cent nickel-silver, as shown at *A*, to be headed as at *B*, and then to be turned to $\frac{3}{16}$ in. in diameter at the opposite end. By an error, several thousand of the rods had been turned before going to the press department to be headed. The problem then was to head the rods without damaging the turned ends.

A sectional die was made, as at *C*, the hole in the center being about 0.004 in. smaller in diameter than that of the bodies of the rods when the die was closed, except at the lower part. Here the hole is of the same diameter as that of the turned ends of the rods. The sectional construction of the die enables it to grip the rods when acted upon by the member *D*, which member is mounted upon the plate slide of a double-acting press. The heading punch *E* is a sliding fit in member *D*, preserving the alignment. The die-holder *H* is machined to accommodate the pins *J* and the springs *K*, which open the die sections on the up stroke of the press.



In operation, at the top stroke of the press, the cam roller *L* has overtraveled the came *M* at the point *N*, and the spring *O* has pulled the cam ring *P* in a clockwise direction until the points *S* of the cam have made contact with the pins *J*. At this time, the die is nearly closed. The work is then dropped into the die, the press is tripped, and member *D* descends until its taper hole compresses the die upon the work. This action grips the work firmly while it is being headed by the heading punch.

When the press starts on its upward stroke, the cam roller makes contact with the cam *M*, rotating it and the cam ring *P* in a counter-clockwise direction. This action opens the die and permits the finished work to drop through it. Just before the top of the stroke is reached, the cam roller overtravels the cam. The die is then nearly closed by the spring *O* acting on the cam ring. During the down stroke, the cam roller idles, or springs out of position, as shown at *T*, until it reaches the low part of the cam, where it is pulled back to its normal position by the spring *V*, to again rotate the cam ring, permitting the die to open as the press travels back on its upward stroke,

To obtain the best results, it was necessary to anneal the large ends of the rods before attempting to form the heads. They were annealed by dipping them into a crucible of melted lavite. The die left little flash to be trimmed off and did not damage the turned ends.

Planer and Shaper Tools for Finishing Soft Brass—*Discussion*

J. T. TOWLSON
London, England

Having had experience for many years in planing materials as diverse as hard steel and ebonite, I am not able to approve the suggestion and the practice of Frank X. Sommers, as set forth in his article under the title given above (*AM*—Vol. 74, page 478). I consider a swan-necked tool having a top rake of 10 deg., and used with a feed of about $\frac{1}{32}$ in., to be the best tool for planing soft brass economically as regards the time taken to do the work.

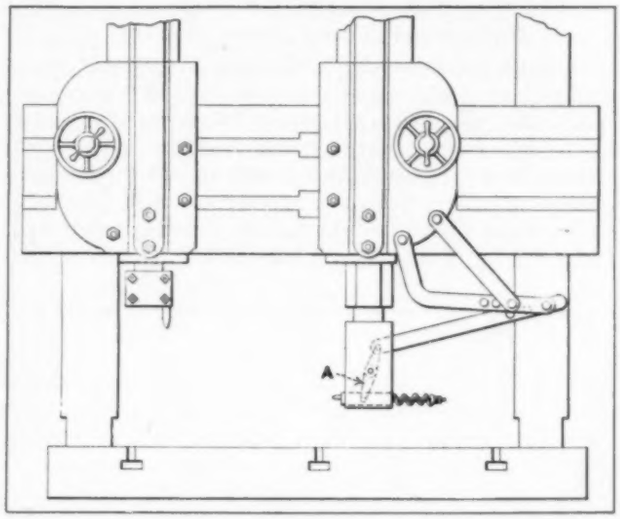
In regard to Mr. Sommers' device for preventing the tool from dragging on and marring the surface of the work on the return stroke, he permits the swinging arms to drag on the work (as he says) to burnish it. While I have equipped all the planers under my control with

tool-lifting devices operated upon the same principle as that described by Mr. Sommers, I thought it best not to have a hard material in contact with the work, so I provided each one with a fiber roller 4 in. long between the swinging arms and let it bear upon the work during the return stroke.

Spherical Turning in the Boring Mill

H. S. WILLIAMS

In order to turn the spherical surfaces of radial buffers, which take the place of the old-type chafing iron and are used between the engines and tenders of many modern locomotives, it was necessary to design a special fixture



for the work. It is often possible to true the spherical surface of a worn buffer by chipping to a templet, but as there is considerable wear, the advantage of turning the buffer at the time of shopping the engine will be apparent. Not all of the surface is turned to the same radius, the corners being chamfered at a radius less than that of the central part. For this reason the radial-turning attachment must be adjustable.

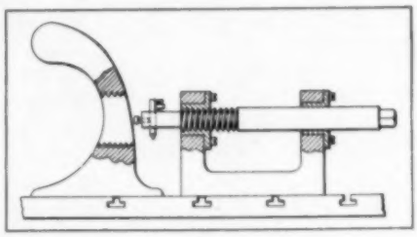
In common with radial attachments for planers, link grinders, and the like, the radial attachment has an arm of the same length as that of the required radius. If this arm were attached directly to the tool slide, the mill could be used to turn a concave surface; but since a convex surface is required, the motion of the tool is reversed by means of a rocker having arms of equal length, as shown at *A* in the illustration. A coil spring holds back any slack that might develop in the rigging. The arms that support the fulcrum point are attached to the head of the boring mill. These arms, the radius bar, and the rocker must be heavy enough not to spring much under the strain of the cut—$1\frac{1}{2}$x$\frac{3}{4}$ in. is about right.

In using the attachment, the body carrying the tool is clamped to the crossrail, as shown, and the toolbar is raised or lowered until the radius bar is horizontal. Then the crossrail is raised or lowered until the point of the tool is at the center height of the spherical surface of the buffer. This insures that the radius will be turned central with the buffer.

Threading in a Radial Drill
Discussion

CHARLES KUGLER

Like all methods that I have seen published on cutting threads in the drill press, the method described by Ed. C. Rendler in an article under the title given above (*AM*—Vol. 74, page 731), does not give any hint as to how the cutting tool was adjusted to clear the work when backing it out, nor how it was adjusted for depth of cut.



In the illustration is shown a fixture that I have used for boring and threading large holes in repair work where the job did not warrant the purchase of a large tap, and where a boring machine was not available. For boring the hole for rethreading, a bushing having a fine thread was placed in one of the bearings, the bushing in the other bearing having a plain hole. A boring bar having a thread to fit the threaded bushing and equipped with a cutter was placed in the fixture and turned by a crank on the squared end. The fine thread was used for feed.

For threading, a bushing having a thread of the same pitch as the one to be cut in the work was substituted for the bushing having fine threads. The chasing bar was, of course, threaded to match the thread in the bushing, thus acting as a lead screw. To regulate the depth of cut and to draw in the cutter to clear the work when the tool was backed out, a piece of steel having a tapped hole for an adjusting screw was soldered to the back of the cutter. An adjusting screw threaded through this piece and bearing on the bar made it easy to adjust the cutter.

While the work and the fixture are shown resting on the plate at the same level, adjustment for difference in height of the center lines can be taken care of by blocking.

Acme Taper Threads—*Discussion*

DONALD RAEBURN
Glasgow, Scotland

Referring to the article under the title given above, by Frank A. Stanley (*AM*—Vol. 74, page 407), the correct setting of the thread tool requires some further explanation. It has always been accepted that the tool should be set at a right angle to the axis of the work, on every class of work (including oil-tool work), and that the angles formed should be equal with the work. Given a correctly-ground flat-topped thread tool set at the height of the lathe centers, the sides of an Acme thread should be correctly machined, but if top rake is given to the tool, the formation of the sides of the threads change.

In the threading of outer and inner surfaces for oil-well tools, the external and internal tools should be made from the same templet gage, so that they coincide to the same forms. These tools should be ground on the flat tops only in resharpening while the machining of parts is in progress. Giving top rake to the tools pro-

duces a rounded surface on the face of the thread, and when the two members are assembled, it will be found that interference takes place at the top corner of the thread and the corresponding corner at the bottom of the thread space. The rounded surfaces referred to cause a rolling movement when fitting the parts together. This is probably part of the trouble and explains the reason for excessive clearance.

But to throw further light on the point raised by Mr. Stanley, I include the following extract from "The Design of Hobs for Taper-Threaded Joints" by Earle Buckingham (*AM*—Vol. 69, pages 759 and 801):

"Mathematically there is but one method that will reproduce exactly the specifications of form given in Fig. 1, and this method is by chasing in a lathe with the cutting edge of the straight-sided threading tool so set that it always remains in a plane that contains the axis of the thread. This would mean a flat topped tool set square and on the line of centers of the lathe. If rake is introduced on the top of this threading tool, or if the tool is set to the helix angle of the thread, there will be a difference in the form of the threads as the diameters change along the taper. Also, such tools and settings will result in a slightly curved profile. With low helix angles, these variations will be very slight; in fact so small that they may not be detected, yet mathematically they are present. There is, however, no superior virtue in the uniform straight-sided thread profile specified on the drawing.

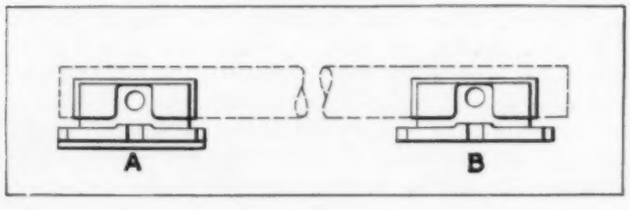
"The essential requirement is that the form of mating threads match each other. Therefore, if a better surface can be produced on the lathe with a chasing tool with top rake set at the helix angle, and the tool and setting are alike for both internal and external threads, mathematically the form of mating threads will be identical, even though this thread form may depart very slightly from a straight line and this form itself change slightly as the diameter changes."

Quoting from an article by Fred H. Colvin, he says, "The cutting of threads on tapers is sometimes the subject of much discussion. Some contend that the thread tool should be at right angles to the taper surface, but it is generally conceded that it better to make the thread at right angles to the center line of the tapered piece." I hope the editor of the *American Machinist* will persuade his friends of the oil-tool shops to write more fully on the positional setting of tools for threading these taper joints in the lathe.

A Floating Outboard Support—*Discussion*

IRA S. WILLIAMS
Western Electric Company, Baltimore Plant

The methods for supporting the outboard ends of long work described by F. H. Mayoh and Henry W. Boehly (*AM*—Vol. 74, pages 553 and 839, respectively) could have been much simplified, and without the aid of any special equipment.

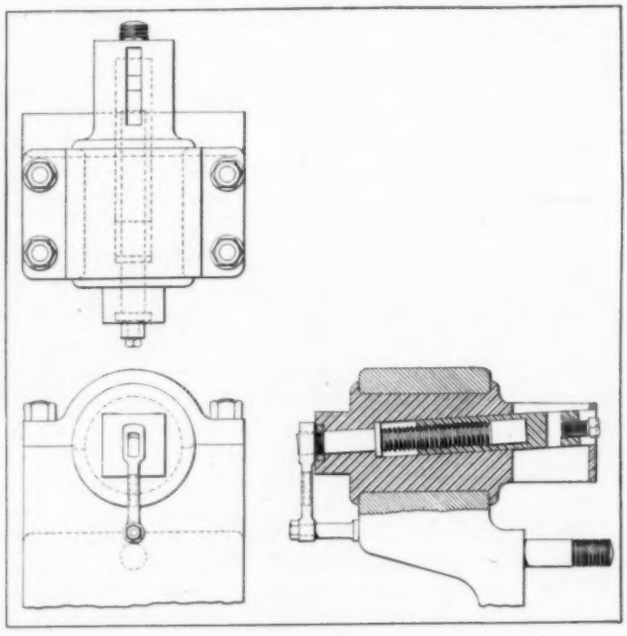


The vise *A* (see illustration) has the customary tongue to fit the slot in the machine table, while the tongue has been removed from vise *B*. To hold the work without springing, it is clamped by one end in the vise *A*, which vise has been attached to the table in the usual way. Vise *B* is clamped to the opposite end of the work, and being free to move, it aligns itself with the work. It is then attached to the table by clamps. The operator should always remember to clamp the vise *B* on the work before making it fast to the table.

Boring Tool for Flue Sheets

D. Q. DUNSTONE
Hetton-le-Hole, County Durham, England

The renewal of the copper flue-sheets used in English locomotives is a very expensive item, so that every effort is made to increase their longevity. While the flue sheets may be of considerable thickness, the holes become so distorted as to require bushing with threaded bushings. In many shops, the holes are reamed with taper reamers and are then tapped for the bushings, using taper taps of about 3 in. in diameter. The work is so heavy that



it is almost impossible to obtain sufficient leverage by the short wrenches that can be applied in either the smokebox or the firebox. I have seen workmen standing on the leading foot plate, struggling with a wrench in an endeavor to turn a tap that was connected to a rod passing through the smokebox and the entire length of the boiler.

The device shown in the illustration was made to overcome this difficulty. The main body forms a bearing that can be attached to the flue sheet by bolts. A collared sleeve is fitted to the bearing, one end being squared for a ratchet wrench, while the other end is slotted to form a driver for the cutting tool. The sleeve is bored at an angle equal to one-half the included angle of the taper

holes. A tool bar, in which the cutting tool is held, is a push fit in the bore of the sleeve, and is tapped to fit a screw for actuating the feed in boring, and also to act as a lead screw in chasing the threads. The feed screw is flattened on the outer end and is prevented from turning on its own axis by a slotted arm attached to the body, as shown.

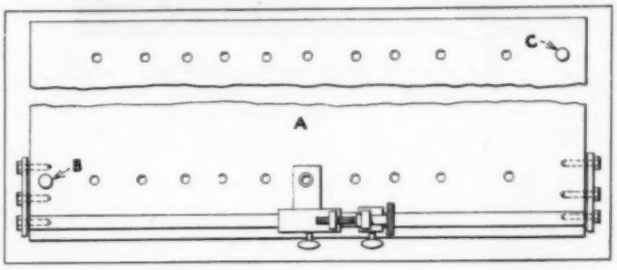
For boring, a broad tool is used, while the threading tool is, of course, V-shaped. By turning the cutting tool end for end in the tool bar, a hole can be bored to have the large part of the taper on either side of the flue sheet.

Locating Device for Drill Holes

EDWIN KILBURN
Proprietor, Kilburn's Machine Shop

Recently the writer was confronted with the problem of accurately locating two rows of holes near the opposite edges of the plate *A*, as shown in the illustration, the holes to be drilled being indicated by circles. While the holes were to be in straight rows, they were to be at varying center distances.

A bushing plate was made to slide on a rod attached to



the plate *A* by brackets at the ends. A clamp sliding on the same rod was connected to the bushing plate by an adjusting screw. Both the clamp and the bushing plate were provided with thumbscrews by which they could be locked in position on the rod. Locating pins *B* and *C* were driven in holes in the plate, being used as points of departure in setting the bushing plate for drilling the various holes. These pins were located from the sides and ends of the plate by a movable plate carrying a bushing, measurements being taken by an inside micrometer between the bushing and squares held against the sides and edges of the plate. The screw holes in the brackets were elongated to permit the guide rod to be located the correct distance from the edge of the plate. Here again the inside micrometer was used, measurements being taken between a square held at the edge of the plate and the bushing in the bushing plate. The results obtained were very accurate.

After locating the guide rod, it was a simple matter to locate the bushing for drilling the holes at the correct center distances. Measurements were made by an inside micrometer between the bushing and pin *B* or *C*, depending upon which side of the plate the holes were to be drilled. The measurements used are those given on the drawing, minus one-half the diameters of the pin and the bushing. After the holes had been drilled on one side of the plate, the holes on the opposite side were located and drilled by repeating the process. By the use of this device, it was possible to get accurate results without making an expensive jig.

SEEN AND HEARD

JOHN R. GODFREY

Efficiency Plus

I MET my friend, the superintendent, at an engineering convention, and we were discussing one of the papers on training foremen. "Did you ever hear of a foreman that was too danged efficient?" my friend asked. "No," I answered. "There ain't no such animal."

"Isn't, eh? Well, I was one. I was with one of the biggest concerns in the country. We'd get an order to equip a whole railroad system or maybe some other big order that several departments had to work on."

This company, my friend went on, had at that time, and still has, a reputation for not filling its orders on time." It was, and is still, too easy with its foremen. But, to go back, when things got in bad shape, first the production clerk would prod, then the head clerk would irritate, then the manager of production would call the foremen on the carpet individually. Finally they would all be called into the G.M's office and the "little man," as they called him, would start lecturing. After the lecture was over, the Prod manager would call the roll of departments to find out what had been done and what was required to be done.

"Mr. Jones, what per cent of work have you done?"

"About 15 per cent."

"Why?" the little man would interject, "Why?"

"I can't get material," the foreman would answer. When it came my friend's turn he would report 90 per cent finished and all material on hand. The G.M. would then hold him up as a model and ask the other foremen why they could not do the same. Until he got into some other kind of trouble because of excess personal energy, he was the white haired boy around there.

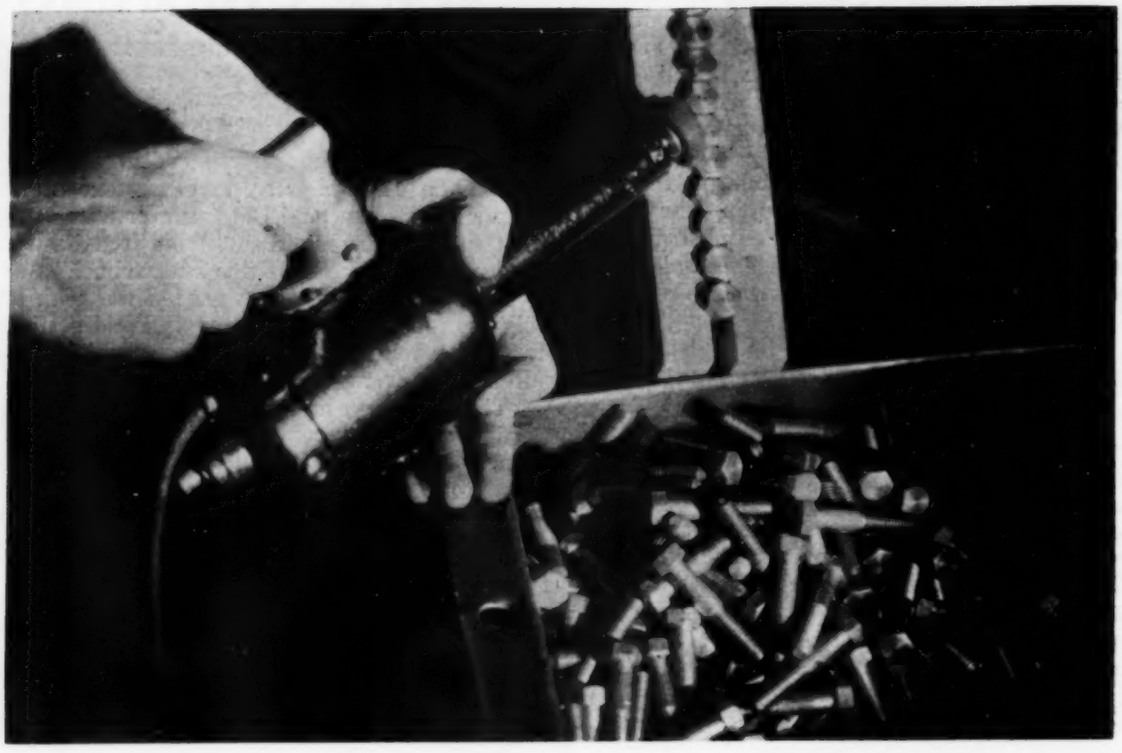
He didn't figure out until much later, that if he hadn't been so efficient and hadn't drawn out all the available material in stores, some of the other departments might have made a start and part of the order might have been shipped long before. Funny thing is, the management didn't tumble either.

Permanent Shave

"IF TUNGSTEN carbide could be made into a razor —and it may be before long—the man with a tough beard would be able to shave for a year without stropping. Then after a few strokes on the smooth side of the strop, the second trouble-free year of shaving would begin." So prophesied Frank W. Curtis, research engineer of the Kearney & Trecker Corporation, in a recent talk. His statement offers consolation for future razor users, but not for those who are turning out these millions of blades a day.

Accidents

MACHINERY manufacturing was one of several important industries with remarkably good safety records in 1930. It ranked eighth in frequency and seventh in severity, the former rate being 24 per cent below the general average and the latter 48 per cent below. Steel, rubber, automobile and textile were the four important industries, in point of "man-hour exposure," with better rates. Twenty-nine machine tool manufacturers, with 17,771 employees working 38,947 man-hours, had 693 lost-time injuries last year.



A specially fitted hand grinder and a pair of goggles are the only necessities for this method of steel testing

The Spark Test

as a Production Tool

A. K. WEST
Timken Roller Bearing Company

Long a metallurgist's "stunt," the spark test is now proving its worth as a means of nondestructive differentiation between alloy steels

THE FACT that steels of different alloy composition give off characteristic sparks when ground has been known for some time, at least direct reference was made to the fact by a French metallurgist over a century ago. For about ninety-odd years of that century the discovery did not arouse much interest, principally because there was no apparent practical application. The number of different alloys produced was small, volumes were not great, and mixing of steel was not important enough to require effective precautions.

Nowadays, however, alloys are compounded for a specific purpose. Substitution of another alloy will in many cases bring about disastrous results, so the importance of absolute segregation becomes vital. Furthermore, present-day mass production, with units handled by thousands, makes speed and economy in any process essential.

What is needed, then, is a fast, economical, and above all certain, means of sorting steels. It is true that several methods of segregation exist, but they do not, for one reason or another, meet the requirements as completely as they might. There is chemical analysis, an absolutely certain method of sorting, but only practicable where a small number of pieces of large bulk are concerned. It necessitates taking samples, which would ruin the parts, and is not particularly fast. Sorting by this method would probably cost more than the parts were worth. Finally, the average plant is seldom equipped with either the laboratory facilities or trained personnel necessary. Fracture tests are positive, but their impossibility is apparent. Hardness tests are eliminated by the fact that when applied to steels having the same carbon content, they are worthless. The spectroscope method is sure, but the instrument is expensive, not readily portable, and a certain amount of technique is required to operate it.

The spark test suffers from none of these limitations, although it has some of its own. It is certain, it is fast, the apparatus required is simple and inexpensive, and while some training is required to fit testers for the work, it is almost purely visual. The process is not, for example, a test for the quality of the steel with regard to laps, seams, hardness, inclusions or grain size. It is in no sense quantitative, therefore cannot be used to determine the analysis of unknown alloys selected at random. While it is a better method of sorting than

those outlined previously, it does not always replace them, especially in the functions for which they are specifically designed. Within its own field, however, it is decidedly valuable. This value lies in the fact that mixed steels, like cats after dark, look almost exactly alike, whether they are in the form of bars, tubes or machined parts. With the spark test they can be separated with a degree of certainty limited only by the carefulness of the tester.

It was a realization of the possibilities of the process along these lines that inspired a thorough investigation in the laboratory of the Timken Steel and Tube Company. The investigation was carried on to determine, if possible, some underlying causes of the phenomenon, and to settle on practical standards for the training of spark testers. It brought to light several interesting things. A plausible hypothesis was developed as to the underlying causes of the phenomenon. When a piece of steel is held on a grinding wheel, small particles are wrenched off with a violence that raises their temperature almost to the point of incandescence. As the hot particles shoot through the air, they come in contact with considerable oxygen, which causes chemical reactions. Carbon steels, for example, show excellently how the hypothesis is borne out by the observed facts. Theoretically, the carbon combines with the oxygen to form carbon dioxide gas at a faster rate than that at which the iron in the particle is itself oxidized. Since the CO_2 gas occupies more space than the original carbon, and the iron is soft, the gas will blow its way free, carrying minute particles of iron with it, which go through the same process in turn.

It has been found that, as the percentage of carbon increases, the frequency and intensity of the bursts and the number of secondary bursts increases. To go back to the hypothesis, the proportion of the gas to the weight of the metal increases, and it is able to throw off larger particles of metal. At 1.0 carbon, in fact, the bursts become small but distinct explosions, and the secondary and even tertiary bursts are much more marked.

Spark identification of steels containing varying percentages of carbon alone is a fairly simple matter, given a little practice. But, since carbon is only one of a number of alloying elements likely to be present, the carbon spark alone is not a sure indication for sorting. Fortunately,

Low-carbon (0.20) tail spark. The burst is comparatively simple

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Typical high-carbon (1.0) steel spark. Bursts are much more marked and complicated

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Nickel - molybdenum "spearpoints." No carbon bursts are evident

investigation has shown that other alloying elements either produce characteristic sparks, or else their presence has a recognized effect on the carbon spark. Nickel and molybdenum will serve as examples. The former produces an intensely white spot of light in the spark line near the grinding wheel. It also seems to have a suppressive effect on the carbon bursts, since their absence or comparative weakness is a definite indication of its presence. Molybdenum has a quite different characteristic, consisting of a flash at the end of the spark line which resembles the point of a spear, and is therefore called the "spear point." Other characteristic sparks were shown previously (*AM*—page 703, Vol. 72).

From the foregoing it can be seen that, given reasonably intelligent material to start with, the development of an effective testing crew should neither take long nor cost much. The material cannot, however, be drafted at random from the shop force; certain qualifications are necessary. One of them is good eyesight, combined with what may be called light-sensitiveness. Because, in many cases identification of steels is a matter of distinguishing quite fine variations in the color and intensity of light. The prime requisite, however, is carefulness, or better yet the capacity for sustained alertness. The man who allows the monotony of watching a thousand similar sparks to dull his perception, or who simply becomes careless and lets the thousand and first piece, which is bad, get through, is not fit for a place in a spark testing crew. Naturally, a certain amount of native intelligence is desirable.

There are no hard and fast rules for training testers; much depends on circumstances. One of the important things is to give men confidence in their ability to distinguish sparks. One way is to start them with simple samples, two steels of extreme carbon range and without other alloys make a good starting point. After these are positively recognized the beginner can be worked up through the more difficult identifications without blurring his impressions of the characteristic sparks. Thus his confidence in himself will be gradually built up instead of being weakened by a multitude of imperfectly registered impressions. The principal requirements on the part of the instructor are patience and a decided aversion for taking the candidate's

ability to recognize sparks for granted. It will also help if the operator is taught some of the simpler theory underlying different spark characteristics. If he knows the reason for certain variations, he will know better where to look for them.

The apparatus used consists essentially of a portable grinder and a pair of safety goggles. Some features of the grinder are rather important and were given much consideration by the Timken laboratory. The grinder finally selected was the Dumore No. 1 JG, having a $1\frac{1}{4}$x$\frac{3}{8}$x$\frac{1}{4}$-in. 46-s wheel. The grinders have been modified from the standard form by the addition of an aluminum handle parallel to the shaft, and are equipped with a push-button switch for controlling the motor. The shaft speed is 15,000 r.p.m., which gives the wheel a peripheral speed of 5,000 f.p.m. This speed, or one nearly approaching it, is practically necessary to give good spark results. Total weight of the grinder is only about 5 lb., so that it is not tiring to handle even when the operator is working on racked material. The goggles, or spectacles, used are designed to serve two purposes, to satisfy safety requirements and to lessen the strain on the operator's eyes. Two types of glass have been found excellent for the latter purpose, one the ordinary blue glass used in hospitals, and the other a light rose-tinted glass known as "Softlite." It is quite likely that investigation would disclose other suitable forms. One other thing might be included, although it is by no means essential, a dark tarpaulin, or cloth, of some sort. It has been found that the best conditions for observing sparks are not, as might be suspected, those of a dark room. A half light, or the light ordinarily found in the factory is better, but sparks should be observed against a dark background. The "tarp" provides the background.

So much for technicalities; now to explain how the spark test may be put to use as a production tool. The best stockroom system is not foolproof; there is always a chance that alloy stock will get into the wrong storage rack, or steels may become mixed before or during shipment. Chances are that parts will be made from the mixed stock before the error is detected.

Let us assume that, in one of the dozens of possible ways, a number of parts of a certain type have been made of different steels having exactly the same appearance. It matters now how the mixing occurred—whether in stockroom, shipment, handling—suffice it to say that the parts are mixed and must be separated. This is a situation in which the spark test proves its great practicability as a production tool. The spark tester can set up shop anywhere in a few minutes. All he needs is a couple of boards or a table and possibly an unskilled helper. Thousands of pieces can be run through in a day, and if the tester has been properly trained, every foreign bit of steel will be sorted out. It is not even necessary for the tester to know what alloys are involved; the mere fact that he must look for two different sparks is enough. The same procedure can be followed in checking the stock; it is not necessary to remove the material from the racks. It is even possible to check assembled, or partially assembled machines, assuming of course that the questionable part is accessible. Otherwise, of course, it may be necessary to partially disassemble the machine.

Center of low-carbon (0.20) spark stream

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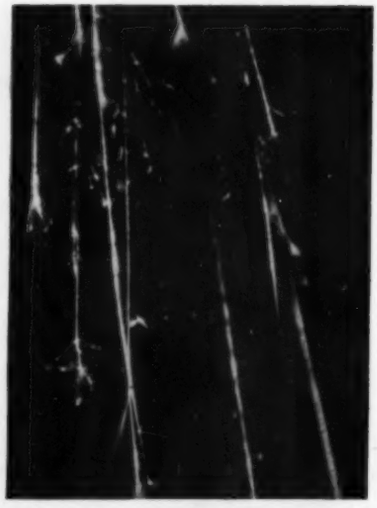

Center of high-carbon (1.0) spark stream. Bursts are frequent and involved

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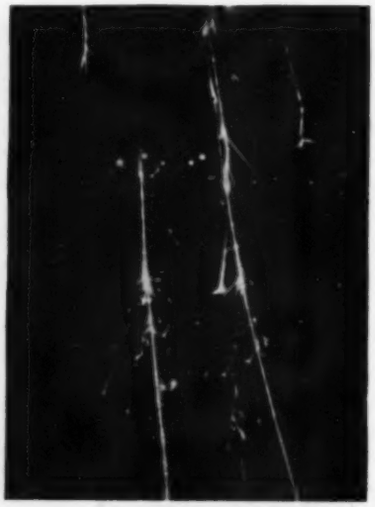

Center of a high-carbon (1.0) spark stream

The beauty of the whole thing is its economy. So little metal is taken off by the grinding wheel in the hands of a skillful operator that the spot can hardly be detected, even on a finished surface. Thus, it is not necessary to scrap a single part, except the foreign ones. This means quite a saving in itself. Furthermore, there is the feeling of restored confidence that inevitably follows the knowledge that the sources of trouble are eliminated all the way back to the stock supply. In other words, trouble that might cost hundreds or thousands of dollars, to say nothing of goodwill, can be eliminated once and for all by the expenditure of a few dollars. It may be argued that the savings would be more than counterbalanced by the investment represented by training a spark testing crew and then having them idling about, waiting for a chance to "do their stuff." The answer is simple; men could be selected and trained as testers, then put on other production work. They could even be trained in off hours. Then they would be available when needed, but would still be useful the rest of the time. And there is always the possibility of "farming them out," at a respectable profit, to other concerns. Thus, it can be seen that the spark test has possibilities that make it of very decided value as an industrial tool with a very practical scope.

AMERICAN MACHINIST

Editors: KENNETH H. CONDIT AND FRED H. COLVIN

New York, July 9, 1931

VOL. 75 NO. 2

Management's Most Important Task

In many industries improved machines and methods have reduced manufacturing costs to remarkably low points. Largely because of these economies management has too often overlooked the savings to be made in management itself.

As an example of possible economies in management we may cite a comparatively small structural steel plant located several hundred miles from the rolling mills and about an equal distance from tidewater. Here, in comparative isolation, and in competition with the largest concerns in the business, structural steel is fabricated into bridges, freight cars and the like. Orders are not confined to local demands, but come from all over the United States. Lower wages are not responsible for the prices that secure the orders. Good management alone seems to be the answer.

Briefly, the reason seems to be that all the details of a job are handled by a very few people and with a minimum of paper work. The chief shop executive knows both ends of every transaction, has his fingers on the delivery of material and the progress of work. He is not the victim of the lost motion that seems to be inevitable in large organizations.

More Facts

Looking backward today, we wonder how the drastic transformation in the business picture at the close of 1929 could have occurred so suddenly, practically unheralded. To be sure, several prognosticators had warned that the accelerating pace of the boom could not continue indefinitely. But by and large, their prophesies failed to convince us, largely because we regarded them as personal opinions unsupported by facts.

On surveying the countless statistics and charts, we may doubt the value of greater detail. At times we have the distinct impression that too many statistics tend to confuse, that the business picture is obscured rather than clarified by the cobwebs of fluctuating curves.

But a more careful inspection discloses that several of our most important business activities have been going on unrecorded. Until recently, we have had no reliable data on unemployment. That greatest of all branches of trade, retail merchandising, has yielded few records. Attempts to obtain a clear insight into investment and speculative habits through brokerage channels have proved fruitless.

Dr. Julius Klein, of the Department of Commerce, promises that many gaps in our business knowledge are about to be closed. Already the machinery for more adequate labor statistics is being set up. The Census of Distribution, of which we have already had samplings, will go even more deeply into consumer buying.

Business judgment is no sounder than the facts upon which it is based. Let us make use of these new figures to avoid repetition of past mistakes.

Machinery and Export Trade

One of our commonest economic blunders is to theorize about foreign trade from the premise that it is a homogeneous entity. Of course, it is anything but that. Exporting wheat or cotton is one thing, exporting gear generators or power excavators is something entirely different.

When we export a raw material we export a commodity that depends largely on natural forces for its quality, and to a very minor extent on what man can do to it. When we export a machine we export a product that depends for its quality almost entirely on human brains and manual dexterity.

Wheat grown in the Argentine is not so very

different from wheat grown in Kansas. You can make good bread from either variety. But machinery built in the United States represents the wealth of education, experience and skill which is the precious possession of American machinery builders, and which has been well able to match its product against those of the machinery builders of other countries.

A bushel of wheat from South America will make as many loaves of bread as a bushel of wheat from North America, and no more. But a machine built in one of the industrial centers of the United States may turn out from two to ten times the product possible from a competing machine of foreign make, and, with few exceptions, the American unit excels in accuracy.

The utility or value of the productive machine obviously cannot be measured by the same yardstick that determines the value of a raw material. So long as the utility of American machinery exceeds that of other machinery it will have a chance in foreign markets, and the generally expanding ratio of machinery exports to total exports indicate that the chance is a good one.

◂◂ CHIPS ▸▸

Hoover moratorium proposal continues to hold the attention of the world; suspense is harrowing as statesmen of several countries seek a formula that will meet Germany's needs and save the French cabinet, none too firmly seated. Italy's prompt action is evidence of the speed with which a dictator can move in emergency. England's proposal for a conference, if America's holiday-tripping statesmen are unable to come to an agreement in Paris, is proof that means will be found to meet the crisis. Details of method are no longer important. Business is taking comfort from the thought.

Sharing the front pages with international economic events have been the accounts of the epic globe-girdling of Post and Gatty, a marvelous feat of endurance by men, plane, motor and instruments. Each such performance makes the world smaller and national isolation less feasible.

Editors of 155 business papers report that business has rid itself of unnecessary burdens and is extremely sensitive to all influences. No general upturn has occurred but signs of improvement are evident in certain fields. Inventories are dangerously low and replacement buying cannot be much longer delayed.

Machine tool orders are being placed by automobile manufacturers, not many as yet, but one or two big ones. . . . Significant of a change in sentiment was the surprising attendance of machine tool users at a recent auction. The auctioneer was equally surprised when they bid practically double his estimated realization figure for the equipment; many tools went at 1929 prices.

Exports of metal-working machinery during May exceeded April exports. . . . During 1930 they ran ahead of 1929, one of the very few items that increased. . . . Milan Fair brought few orders for machinery but started many deals that will result in orders when the tide turns. . . . Germany gets bulk of Italian machinery business, will get more if Austro-German customs compact goes through, practically extending her borders to the Italian frontier, and making it as easy for her to sell Italy as for Detroit to sell Ontario.

Trade associations have gained twenty-five per cent in membership, seventy-three per cent in income since 1921, according to U. S. Chamber of Commerce figures. . . . Listed among the strongest associations is the National Machine Tool Builders' Association. . . . Census announces total retail sales for 1929 of 52 billion dollars. . . . Two-thirds of our manufactured goods is absorbed by industry, one-third is sold to the domestic consumer, an interesting contrast in the relative importance of markets and a guide for sales planners.

Ambrose Swasey gives another $250,000 to Engineering Foundation for engineering research. . . . M. J. Kearins becomes president and general manager of Latrobe Tool Company and J. M. Carpenter Tap & Die Company. . . . Sir Hugh Bell, British ironmaster, dies at 87. He made the headlines only a few days ago with his statement that protection would ruin the British iron industry. . . . Richard Gilpin Wood, former president of Alan Wood Steel Company and a chevalier of the French Legion of Honor, dies in his eighty-third year.

Somebody else is worried about the Machine Age, the four major engineering societies and Engineering Foundation will conduct symposium

on "Engineering Progress" to prove that favorable aspects outweigh unfavorable ones. . . . Russian engineers are engaged in a standardization program as ambitious as the 5-year plan.

THIS WEEK IN *AM*

Many a manufacturer, who has been having trouble in his assembly department, may be surprised to learn that with ordinary gaging a round part may be passed as round and yet be anything but that. Harry Shaw, of Shaw & Son, tool and gear consultants, Heywood, Lancashire, England, has investigated the subject of gaging with typical English thoroughness, and presents his findings (page 43).

William J. Tangerman, shop superintendent, Union Metal Products Company, shows in detail all the operations concerned in the stamping of heavy hopper car doors (page 57).

Every shop has operations that apparently call for special machines. Think twice before going ahead with them and read what has been prepared by Douglas T. Hamilton, advertising manager, The Fellows Gear Shaper Company (page 53). If your shop is thinking about putting in new enamelling equipment, spend some profitable minutes with A. E. Maehler, general manager, The Paul Maehler Company (page 47).

FOUR RELATED ARTICLES

The extended use of jig borers and the advent of the Monarch-Keller form turning lathe have increased greatly the importance of geometrically accurate templets. Six months ago we published two articles on "Redimensioning for the Jig Borer" describing the importance of accurate templets for die work. Next month an article entitled "Turning by Templet" will show the importance of the templet in making molds, form cutters and symmetric shapes. To meet this demand for accurate templets two methods are offered: one, "Originating Precision Templets," in the present issue, describes and illustrates a method of producing them accurately by hand. In the article to be published next month the possibility of making templets directly from the drawing is hinted at. What appeared rather visionary when this article was written has come to pass, and still another article, to be published later, will describe a machine for making templets, formed tools, etc., directly from a sketch or drawing.

We believe that these four articles, taken together, constitute the most important advance in tool-making technique in a decade.

NEXT WEEK

Twice each year *American Machinist* brings forth its Semi-Annual Shop Equipment Review. While designers have been working day and night to bring out 575 new and improved models, we have been taking advantage of our spare Sundays and evenings to work out condensed descriptions of every Shop Equipment News item published from January 1 to June 30, 1931. The July 16 number will be welcomed, read and preserved by every forward-looking executive in the industry until the next Semi-Annual Shop Equipment Review comes from the presses in January, 1932. The 575 total includes 417 American items, 158 from the European edition.

• MEETINGS •

THE INDUSTRIAL INSTITUTE
Silver Bay on Lake George, N. Y., Aug. 10-25, Charles R. Towson, secretary, 347 Madison Ave., New York, N. Y.

NATIONAL METAL CONGRESS AND EXPOSITION
Exposition on Commonwealth Pier, and Congress sessions at Hotel Statler, Boston, Mass., week of Sept. 21. Information from W. H. Eisenman, Secretary A.S.S.T., 7016 Euclid Ave., Cleveland, Ohio.

SOCIETY OF AUTOMOTIVE ENGINEERS
National Production meeting, Detroit, Mich., Oct. 7-8. Headquarters, 29 West 39th St., New York, N. Y.

NATIONAL SAFETY COUNCIL
20th Annual Safety Congress, Chicago, Oct. 12-16. Civic Opera Bldg., Chicago.

SOCIETY OF AUTOMOTIVE ENGINEERS
National Transportation meeting, Washington, D. C., Oct. 27-29. Headquarters, 29 West 30th St., N. Y. C.

AMERICAN MANAGEMENT ASSOCIATION
Annual Convention, New York, N. Y., Nov. 17-19, devoted to the general theme of Coordinated Industrial Planning. Headquarters, 20 Vesey St., New York, N. Y.

AMERICAN MANAGEMENT ASSOCIATION
Industrial Marketing Conference, Cleveland, Ohio, Oct. 14-16. Headquarters, 20 Vesey St., New York, N. Y.

INTERNATIONAL INDUSTRIAL RELATIONS CONGRESS
To be held at Amsterdam, Holland, Aug. 23-29. Information from Mary van Kleeck, Russell Sage Foundation Building, New York, N. Y.

UNIVERSAL CRAFTSMEN COUNCIL OF ENGINEERS
Annual meeting, Stevens Hotel, Chicago, Aug. 4-8. T. H. Jones, 33 Linden Ave., Cherrydale, Va., is grand secretary of the council.

INTERNATIONAL CONGRESS FOR TESTING MATERIALS
First Congress of the new International Association for the Testing of Materials, Sept. 6-12, buildings of the Swiss Federal Polytechnicum, Zurich, Switzerland. C. L. Warwick, secretary-treasurer, American Society for Testing Materials, 1315 Spruce St., Philadelphia; or W. H. Fulweiler, A.S.T.M. Representative on the permanent committee, chemical engineer of the United Gas Improvement Co., Philadelphia.

Progress in Metal-Working and Machinery Markets

AUTOMOTIVE sales were again the week's strong point. Chevrolet has purchased a substantial number of gear-cutting machines and some other equipment, Chrysler has purchased some tools, and other districts report a quickening of demand from automobile and accessory sources. Beyond this, conditions remain about as they were, with tools going slowly after much selling effort, inquiries lagging until they are practically forgotten, and used tools scarcely wanted even after prices have been beaten 'way down. The whole situation is reminiscent of a toy shop, with every unit ready to go if someone touches the button—and keeps it touched.

NEW YORK reports the Chevrolet gear-cutting machine order, a prospective list from the new subway for its 210th St. shops, and continuing Navy and governmental inquiries. Canada activity has dropped off a little, big buyers slowing up while smaller prospects show increased interest. Los Angeles notes a change for the better, but only in rebuilt tools, while schools do most of the buying. Indianapolis is depressed, although—as everywhere else—the fall is expected to turn things up. Chrysler and Perfect Circle are buying there. Cincinnati suspects a buying moratorium, with orders by the Navy department and automobile builders the principal sales. Selling agents made a few sales and developed a few prospects.

NEW ENGLAND also reports the stir from the automobile field, steady foreign demand for grinding machines and better-than-average government business. Chicago joins Indianapolis in its dirge of depression. Detroit believes it is on the verge of some good sales, but is fearful of being over-optimistic, even though several dealers there have received good orders recently. Southern District continues spotty.

NEW YORK

A very substantial order for gear-cutting machines, placed with an Eastern manufacturer by Chevrolet for the Toledo plant, and reports of several other good-sized machine-tool orders from the same source placed in other districts were cheering signs last week. The Brooklyn Navy Yard list probably will be divided between several dealers. A 20-tool inquiry for the 210th St. subway shops is expected within the next 30 days, and single inquiries from the Navy continue. Last week's included some for radials, millers, and small lathes. Beyond these high spots, the month, and the week, show little change.

CANADA

Sales during the last fortnight have not been quite so brisk, although there is nothing in the situation to warrant pessimism. So much industrial expansion is in prospect that demand is bound to manifest itself soon. While locomotive, car and structural steel manufacturers and foundrymen are but lightly employed, other metal-working plants have shown gains. Manufacturers of electrical equipment and automobile parts and accessories report fair demand with prospects of a quickening of activity during July and August. Plants producing road-building equipment have orders to keep them busy for the remainder of the summer, while there is also a steady call for special equipment for harbor improvement.

LOS ANGELES

If any change has occurred, it is for the better. This applies particularly to rebuilt equipment. School shops and manual training schools are making some purchases. Oil tool shops and motion picture studios are maintaining their reduced schedules. Little direct benefit has as yet resulted from Boulder Dam operations.

INDIANAPOLIS

Demand appears to be at its lowest ebb. A good volume of inquiries being received is encouraging, and most dealers feel that the fall season will develop real business. At that, the summer lull is not more drastic than it was last year. Refrigerator factories at Evansville and Fort Wayne are now tooled up. The steel industry also is buying little equipment.

One of the bright spots is demand from transmission factories. The last two weeks have seen an increase in demand from automotive factories, Chrysler in particular. Some items have been sold to Perfect Circle at Hagerstown. This company promises to be in the market for more, since it is breaking all previous records for sales and production. Dealers in used machinery and tools report stagnation.

CINCINNATI

The holiday seems to have caused most machine tool users to declare a buying moratorium. Some orders were placed by the Navy Department and by makers of automobiles. General business was well diversified and well scattered. Selling agents effected a few sales and had some success in developing prospects. A fair volume of inquiries for single tools was received.

NEW ENGLAND

Although the situation is spotty, a few developments have occurred to bring renewed hope. A stir from the automobile field, steady foreign activity in grinding tool centers and better-than-average government demand are responsible. Executives feel there is more importance attached to the resulting improvement than actual orders would tend to signify.

CHICAGO

Reports from various sources are to the effect that the machinery business is at the lowest point experienced in years. New inquiries continue, but in lessening number, and are by no means of an urgent nature. Old inquiries, accumulated during many months, seemingly have been forgotten by those submitting them.

DETROIT

Despite continued lassitude, recent currents in the automotive industry have proved unusually encouraging to machinery and machine tool dealers. There has been no material change, but several dealers are actually predicting a turn in affairs. This is not based on orders on hand, but rather on the conviction that the motor industry is about to "open up." Changes yet to be decided on in several motorcar lines give one basis for the shift in sentiment, and in a few cases improvements in business during the last two weeks lend point to the predictions.

SOUTHERN DISTRICT

The first six months of 1931 closed an unsatisfactory record, with the last two weeks of June showing up decidedly poor. What appeared to be a good beginning for the trade snapped sharply after the end of March and continued through the end of June.

Hopes are held out for gradual improvement, and some dealers are optimistic over what they regard as "better buying trends" in other lines. Conservative expression, however, is to the effect that little improvement is in sight, at least for the next 60 to 90 days. Sales have been spotty. Few inquiries of more than sectional interest were reported, and these were small.

WEEK . BY . WEEK

BUSINESS BAROMETER

Trends in General Business throughout the world

THEODORE H. PRICE
Editor, Commerce and Finance, New York

In an economic sense the world is rapidly becoming smaller as the facilities for transportation and communication are increased. Two aviators have just encircled the Globe in less than nine days, and the trans-Atlantic telephone service has been extensively used in the negotiations that followed President Hoover's suggestion of a moratorium for the inter-governmental debts arising out of the World War.

In the face of developments and inventions that are so wonderful and revolutionary, it is not surprising that men are willing to believe almost anything. This willingness is in no small degree responsible for the sudden and amazing change of feeling that has come over the world of business since America took the lead in proposing a year's holiday from war debt payments.

This proposal has led the principal debtor nation to cherish the hope that its creditors may ultimately be brought to see that it is more profitable to forgive than to collect punitive debts. In this hope some of the more benignant advocates of peace have been dreaming of a disarmed world in which all war debts shall be things of the past. From this vision it has been but a step to another picture of a world in which everyone was at work, and the industrial and distributive machinery was so nicely adjusted that production and consumption were always in equipoise.

Of course, these are fantasies whose realization is unlikely, but they have a strong appeal for the public imagination, and when the crowd is in the mood it sometimes seems to take their future existence for granted. This is well, for "where there is no vision the people perish," and it would be a drab and depressing world if imagination did not occasionally outstrip the facts.

France's Attitude Chills Enthusiasm

Last week's markets furnished an apt illustration of this. The attitude of France has somewhat chilled the enthusiasm with which President Hoover's proposal was generally greeted. Everyone hopes, and most people believe in its ultimate acceptance by the powers involved, but France has attempted to impose special conditions that the other powers have not insisted upon.

From her standpoint France may be wise in maintaining the position that she has taken. Her angle of incidence differs from that of the other powers, and we may not be able to appreciate it. But the whole cannot exceed the sum of all its parts, and Germany cannot pay more than she has or is allowed to make. For these reasons it is to be hoped that some way of putting her on a paying basis will soon be found, and if it is, the boom of two weeks ago will be a small matter when compared with the widespread business revival that will come to a world in which all those who can work are profitably employed. In imagination, the markets had a foretaste of this condition during the fortnight which succeeded President Hoover's announcement. The inevitable reaction came when France was revealed in opposition to the moratorium. Whether she will yield or not is an open question. There are many reasons why she should, and many other reasons why she should not. But a negative attitude, if France chooses to maintain it, will not be as depressing as some think, as it will reveal the impotence of a single power in opposition to the public opinion of the world.

Her position is deemed by President Hoover to be sufficiently strong to justify the offer of some concessions, though at the same time he has warned her of the dangers involved in a collapse of Germany's economic structure which may follow a failure to accord relief.

Acute Stage of Depression Past

Therefore, the markets have shown a disposition to recover the declines that have been registered from time to time, and a careful study of the situation confirms one in the belief that the acute stage of the depression has passed, and that the general trend of prices in the immediate future will be upward.

This is certainly true of the commodity markets as well as of the Stock Exchange. The demand for securities has been excellent, even at prices that were substantially above the low figures touched in May. In the commodity markets the strength has been even more impressive.

Car loadings and railroad traffic are still running below last year, but there now seems reason to expect that the railroads will be given at least a portion of the advance in rates for which they have petitioned, and with money in abundant supply at the lowest rates ever known there is every reason why the good crops that the country will soon be harvesting should bring us prosperity.

Perhaps we took it for granted that President Hoover's moratorium would work a miracle. The age of miracles is past, but all the essentials of prosperity are here, and it is only necessary that we should be judicious in their use. The other day a prominent man of affairs said the trouble with us Americans is that we are never happy unless we are extravagant. Perhaps this may explain the feeling of depression that was so widespread until recently. Happily it seems to have passed, but to prevent its recurrence extravagance should be avoided.

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THE BUSINESS WEEK

July 8, 1931

As the second half begins, the business outlook oscillates uncertainly in the sensitive balance of sentiment. . . . The psychological stimulus of the moratorium and other emergency efforts to ensure stability in the situation abroad has slackened. . . . Security and commodity markets have sagged or are marking time till favorable news offers further nourishment for enthusiasm. . . . Meanwhile business indicators, except in certain sensitive retail lines, still register no concrete effect of increased confidence. . . . Our index, estimated early on preliminary figures for the last week of June, indicates a further recession, reflecting intensified seasonal contraction of activity. . . . Still it is increasingly evident that the explosive materials for a major upswing of surprising speed and proportions are accumulating in the unprecedented credit position of the Reserve system, the curious currency situation, the continued imports of gold, the abnormally unbalanced condition of commodity stocks. . . . These factors alone are automatically forcing a reversal of deflation, and are being strengthened by decisive considerations of domestic and international political and financial policy, all pointing imperatively toward credit expansion and price restoration. . . . They are bound to bring recovery in the course of time, and the longer the delay the more powerful their explosive force is likely to be. . . . All that is necessary to set them off is a sufficiently sustained spark of general confidence, generated by electric leadership.

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Material Trends and Prices . . . .

The upward movement of a week ago still continues in prices of non-ferrous metals, with the advances of the week reflected in higher quotations for the alloys, fabricated forms and even scrap. Steel prices do not gather strength, it appears, actual declines having developed in minor shop supplies during the last week. Steel-scrap quotations remain at record low levels. It is likely that steel production has reached the low point of the year, there being but little buying at present, except for railway requirements.

(All prices as of July, 3, 1931)

IRON AND STEEL

Pig Iron—	Current	Mo. Ago	Yr. Ago
Birmingham, No. 2, Fdry., per gross ton	$12.00	$12.00	$12.70
Buffalo, No. 2, Fdry., per gross ton	17.00	17.00	16.20
Heavy Melting Steel Scrap— Pittsburgh consuming point, No. 1, per gross ton	9.50	10.00	14.75
Furnace Coke—Connellsville, per net ton	2.40	2.40	2.50
Foundry Coke—Connellsville, per net ton	3.25	3.50	3.50
Steel Shapes—Pittsburgh, base, per 100 lb	1.65	1.65	1.65

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Iron Machinery Castings—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight, 275 lb.:

Chicago	4.62½	Cleveland	4.75	New York	4.75
Cincinnati	4.40	Detroit	4.00		

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Steel Sheets—Prices in cents per lb., del. from warehouse stock (except at Pittsburgh) in lots of 401 to 999 lb., ordered and released for shipment at one time:

	Pitts. Mill	Chicago	Cleveland	New York
Blue annealed, No. 10*	1.85	3.20	3.00	3.40
Black sheets, No. 24	2.15@2.25	3.55	3.60	3.50
Galvanized, No. 24	2.70@2.80	4.10	4.00	4.00

* Light plates.

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Seamless Steel Tubing—Cold-drawn mechanical tubing, round, .10 to .30 carbon, in lots of less than 100 ft. or 100 lb., net, at N. Y. warehouse:

—Thickness— of Wall		Outside Dia. in Inches					
		⅛	¼	¾	1	1⅛	1¼
Inches	B.w.g.	Price per Foot					
.035	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23

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Shapes, Plates, Bars, Etc.—Warehouse base prices in cents per lb., del. in lots of 401 to 999 lb., ordered and released for shipment at one time:

	New York	Cleveland	Chicago
Bands	3.40	3.20	2.95
Bars, soft steel	3.10	2.95	2.75
Cold fin., flat or square	3.90	3.90	3.60
Cold fin., round or hexagon	3.40	3.40	3.10
Cold rolled strips	4.95	6.00	5.50
Floor plates	4.85	5.00	5.00
Hoops	3.75	4.00	3.50
Rivets	4.00	4.00	4.00
Shapes	3.10	2.95	3.00
Spring steel	4.00	4.00	4.00
Tank plates	3.10	2.90	3.00

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Stainless Steel—Hot-rolled bars, base, Pitts., cents per lb.:

Chromium, 15%, carbon 0.12% and under	19.00
Chromium, 15 to 18%, carbon 0.12% and under	20.50
Chromium, 18 to 23%, carbon 0.12% and under	23.00
Chromium, 23 to 30%, carbon 0.12% and under	28.00

Bolts and Nuts—Discount from list, f.o.b. mills, Birmingham, Chicago, Cleveland and Pittsburgh, on machine bolts, all sizes, cut thread; nuts, hot-pressed or cold punched; and lag screws, mill lots ..... 73@10%

NON-FERROUS METALS

Prices following are in cents per lb. for mill shipments in carlots:	
Aluminum ingots, 99%, N. Y	23.30
Copper, electrolytic, Conn	9.00
Copper wire, base, Chicago and Cleveland	11.12½
Copper wire, base, N. Y	11.00
Lead, pigs, E. St. Louis	4.22½
Tin, Straits, pigs, spot, N. Y	25.00
Zinc, slabs, E. St. Louis	3.90
Prices following are in cents per lb., base, N. Y., Chi. and Cleve:	
Brass rods, high	14.50
Brass sheets, high	16.25
Brass tubing, high	21.12½
Copper, drawn round	17.37½
Copper sheets	18.87½
Copper tubing	21.37½
Prices following are in cents per lb., del. from N. Y. warehouse:	
Babbitt, anti-friction, general service	28.50
Babbitt, com'l, intermediate grade	34.00
Babbitt, genuine, highest grade	45.00
Solder, bar	19.37½
Prices following are in cents per lb., base, Huntington, W. Va:	
Monel metal rods, hot rolled	35.00
Monel metal sheets, full finished	42.00
Monel metal tubing, seamless	65.00
Nickel rods, hot rolled	45.00
Nickel sheets, full finished	52.00
Nickel tubing, seamless	75.00

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Scrap Non-Ferrous Metals—Dealers' purchasing prices in cents per lb., f.o.b. cars:

	New York	Cleveland	Chicago
Heavy yellow brass	3.25	4.25	4.00@4.25
Light brass	2.25	3.25	3.25@3.75
No. 1 rod-brass turnings	4.00	4.50	4.00@4.50
Heavy copper	6.12½	7.00	6.25@6.75
Light copper	5.12½	6.00	5.50@6.00

SHOP SUPPLIES

(Prices at warehouse)	New York	Cleveland	Chicago
Abrasive disks, aluminum oxide mineral, cloth, 6-in. dia., No. 1, less than 200, per 100	$4.36	$4.59	$4.59
Belting, leather, heavy, discount	30@10%	30–5%	40%
Belting, rubber, trans., 1st grade, discount	60–10–10%	50–10%	60%

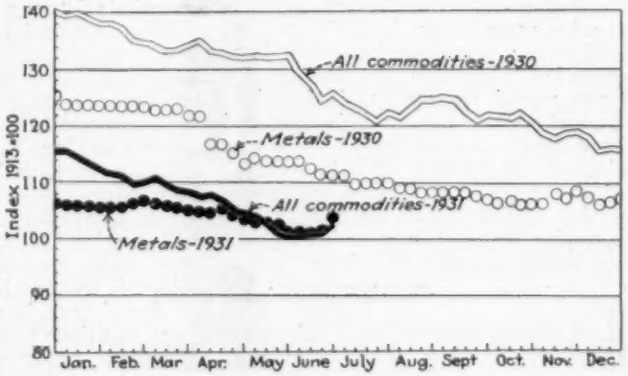
Lumber—Per M ft., b.m., 16 ft. lengths, del., N. Y.:

Crating—Southern pine:

1x4-in. ..... $25.00 1x6-in. $28.00

Skids—Spruce:

2x4-in. .$40.00 3x3-in. .$40.00 4x6-in. .$42.00 6x6-in. .$52.50



Price Indexes Week by Week

(6 Metals and 74 Commodities—Figures from The Annalist.)

SHOP EQUIPMENT NEWS

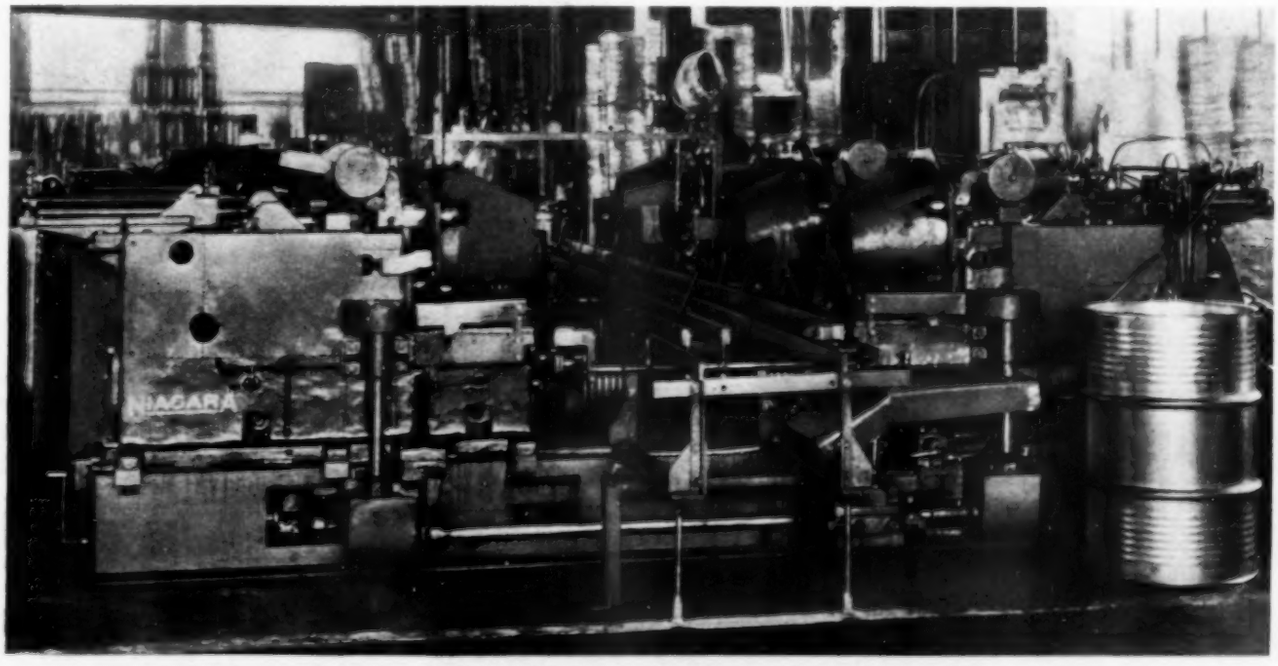
Niagara Automatic Drum Manufacturing Machines

For the automatic production of steel drums, the Niagara Machine & Tool Works, Buffalo, N. Y., has built the four units illustrated for the Atlas Steel Barrel Corporation, Bayonne, N. J. These four units automatically flange, bead and corrugate steel drum bodies. In order to attain the specially high and well-defined rolling bead desired by drum manufacturers, two units are used to accomplish this purpose. The first unit expands the rolling beads and the second unit rerolls them to their final shape and height. These beads offer greater resistance to crushing and denting, and being more narrow and more perfectly round and free from ridges, the drums roll with comparatively little effort.

The line-up of drum manufacturing machines is shown from the finishing end. Starting at the other end, the welded drum shell is placed on the reciprocating conveyor and passes through the flanging unit, bead expanding unit, bead rerolling unit and finally through the corrugating unit. All machines operate on both ends of the drum simultaneously. Production is five completed steel drums per minute.

When used in groups, these drum manufacturing machines are closely coupled, and thus occupy a minimum amount of floor space. All motions except the rotation of the rolls are produced by hydraulic cylinders. The hydraulic pumps are of the high-pressure type, with suitable valves and automatic controls. Each unit is operated by two motors, one for rotating the rolls, and the other for driving the hydraulic pump. Should a drum body of undersize diameter or oversize in length enter the line-up of machines, the first unit will stop automatically. The succeeding units will continue in operation until the remaining drum bodies in line have been completed, and then will also stop automatically. The sliding heads on these machines are equipped with tapered guide plates of heavy steel. These enter the drum bodies whether they are round, oval, dented or misshapen, rounding and centering them for the correct functioning of the rolls.

The units can be adjusted and tooled for diameters ranging from 9½ to 24 in., and will accommodate lengths from 14 to 42 in. Since the rolling beads are not used on very small drums, the bead-expanding unit is limited to a minimum diameter of 18 in., and a minimum length of 24 in. Any one of these units can be furnished independently. The flang-



Battery of Niagara Unit Machines for flanging, beading and corrugating steel drum bodies automatically, as seen from the finishing end. Production, 5 drums per min.

ing unit, which contains the feed actuating mechanism, should be installed first, and then all the other units may be added later.

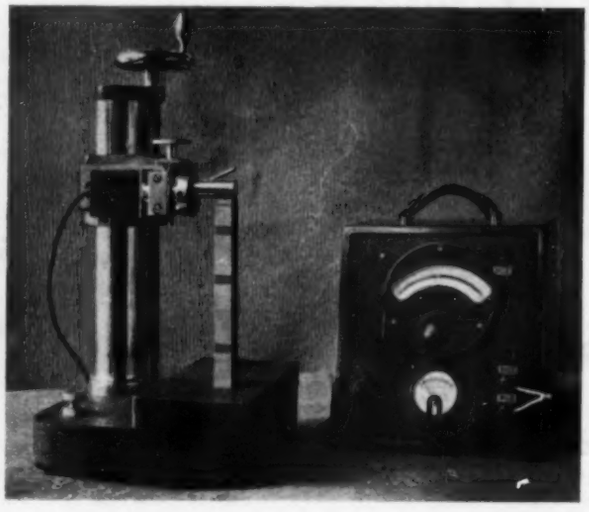
Pratt & Whitney "Electrolimit" Gage

An "Electrolimit" gage is being marketed by the Pratt & Whitney Company, Hartford, Conn. The electrical parts are of General Electric manufacture.

The Electrolimit gage is an extremely sensitive and accurate comparator, suitable for checking work within very close limits and is applicable to quantity production. It consists essentially of a small gaging head which carries a pointer to contact with the work. Movement of this pointer changes the balance of the electric circuit, so that errors from true size are indicated by a needle traveling over the scale of an indicating instrument. Electrical magnification from 500 to 10,000 times is possible, so that the gage can be used for a wide range of limits. The length of the scale is 5 in. The Electrolimit gage has been used in selecting machined materials into groups on a 0.0001-in. basis for both inside and outside diameters, allowing assembling of parts on the same basis. This eliminates the necessity for handling materials several times for hand fitting.

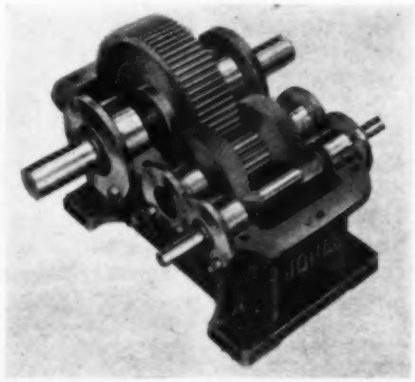
The company is designing a standard gaging head to be used in conjunction with the General Electric indicating electrical devices. Standardized brackets and fittings will be available for mounting the gaging head for various types of work.

As shown in the accompanying illustration, the Electrolimit gage is available for either external or internal work. It can be set quickly to the accuracy required, after which the operation of gaging does not need to be performed by skilled toolmakers. No sense of "feel" is required, as the gaging is done entirely by the variation of an electrical circuit, which is transmitted to the pointer in the instrument. The position of the pointer either inside or outside the two limit marks indicates whether the piece will or will not pass inspection. When being used for external work, Hoke precision gage blocks are used to set the upper and lower limits desired. For internal work, two master solid ring gages representing the "go" and "not go" dimensions are needed to set the gage. These rings are slipped in turn over the gage spindle and rotated once.



Jones Herringbone-Maag Speed Reducers

A series of small herringbone-Maag speed reducers has been developed by the W. A. Jones Foundry & Machine Company, 4401 W. Roosevelt Road, Chicago, Ill. The capacities range up to 18 hp., and the reduction ratios from 12 to 1 up to 48 to 1. The



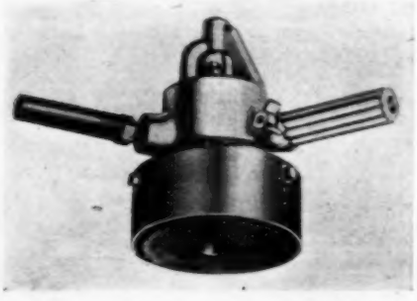
smallest reducer in this series is $20\frac{5}{16}$ in. long and $14\frac{1}{4}$ in. high, and the base measures $10\frac{1}{4}$ in. wide.

For universal application all the reducers in this series have high- and low-speed shaft extensions on both sides. This eliminates the need for a right- or left-hand assembly. Two shaft guards are provided.

On the high-speed side the herringbone gears and the high-speed pinion teeth are generated by rack-shaped cutters, with straight sides, used in a precision gear planer. On the low-speed side the Maag spur-tooth form is used for the gears because of the greater strength. This combination makes for an efficient, quiet reducer. Timken roller bearings are used throughout these units.

Ingersoll-Rand "Multi-Vane" Surface Grinder and Sander

A portable Size 4F surface grinder and sander has been announced by the Ingersoll - Rand Company, 11 Broadway, New York, N. Y. This machine is suitable for grinding, sanding, polishing, and wire-brushing operations. It is built with two handles so that the operator can readily hold it at right angles to the working surface. One of the handles may be removed to facilitate working in close quarters. The second handle acts as the air inlet and contains a thumb-controlled throttle

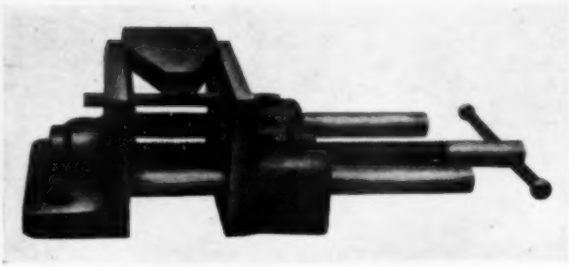


valve. The standard free speed is 4,600 r.p.m., but units can be furnished for higher or lower speeds. The weight is $10\frac{3}{4}$ lb., without the adjustable guard for the grinding wheels. Over-all length is $9\frac{1}{4}$ in.

Eagle Four-Point Drill Press Vise

The Eagle Engineering Company, Springfield, Ohio, has acquired all patent rights and equipment for the manufacture of a drill press vise

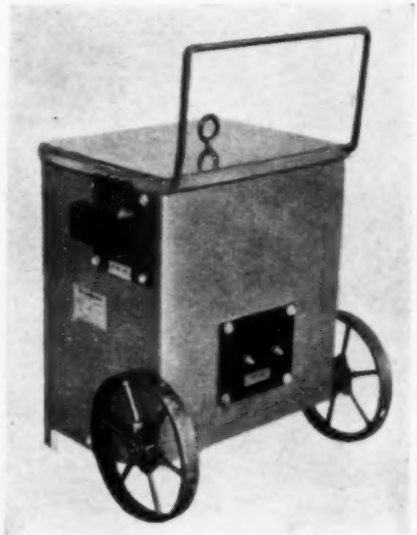
from Demco, Inc., Baltimore, Md. This four-point vise grips and supports symmetrical or irregular work, and will prevent sagging or twisting of the work, eliminating drill and tap breakage. The design gives clearance for the drill and tap. The milled jaw ledges and the cross rods are on the same plane, thus providing a uniform bearing support for the piece. Fragile work can be handled without crushing. The vise jaws are of a semi-steel and machined on four sides. Two V-slots are provided, one parallel to the top and the other at 90 deg. The jaws are independently movable and either jaw may be clamped to the table.



Eagle Drill Press Vise, which holds irregular work on the jaw ledges and cross-rails

Westinghouse "Flex Arc" A.C. 100-Amp. Welder

For arc-welding thin-gage material, The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has developed a "Flex Arc" a.c. 100-amp. welder designed for operation at between 8.5 and 125 amp. It is suitable for use in the manufacture of metal furniture, sheet-iron cabinets and containers; in aircraft fabrication work; in fabrication and erection of ventilating and materials handling equipment, and job and garage repair work. It may be used in conjunction with either bare or coated electrodes from $\frac{1}{32}$ to $\frac{1}{8}$ in. Many of the ferrous alloy materials commonly used with reversed polarity direct current are effectively applied in conjunction with this machine. It is useful for welding aluminum.



The equipment consists of a special self-cooled transformer, a short-wave arc control system and current regulating details mounted in a compact, welded steel case. A special high-frequency arc stabilizing circuit eliminates the usual high open-circuit secondary voltage. The maximum open-circuit voltage at the work is only 73 volts, thereby assuring safety to the operator.

"Manganweld" Electrode

For building up worn manganese steel castings by means of the "shielded arc" process, the Lincoln Electric Company, 12818 Coit Road, Cleveland, Ohio, has developed the "Manganweld" electrode. This electrode produces a weld with the structure and qualities of wear-resisting cast managanese steel. It contains from 11 to 15 per cent manganese, and the weld is air-toughening which eliminates the necessity for quenching the bead. A heavy extruded coating provides a shielded arc. Manganweld causes the weld to remain in the austenitic state even on slow cooling.

Manganweld as deposited has a Rockwell C hardness of 5 to 10, and after cold working attains a Rockwell C hardness of 45 to 50. The electrodes are used with reversed polarity. In using the electrode, the work should be free of rust and precautions should be taken to keep the work cool, although the deposited metal does not need to be quenched. The weld metal should be deposited in pads $\frac{1}{2}$ to 1 in. wide and not more than 3 in. in length. Long narrow beads should be avoided. After each pad is deposited it should be hammered to stretch the metal and thus compensate for the shrinkage which takes places in cooling.

Manganweld electrode is manufactured in $\frac{1}{8}$, $\frac{5}{32}$, $\frac{3}{16}$ and $\frac{1}{4}$ in. sizes of the standard 14-in. lengths.

Oliver Motorized Pattern-Shop Sander

A large-size, motor-shaft type of double-disk sander for pattern shops is now being manufactured by the Oliver Machinery Company, Grand Rapids, Mich. This sander carries two 37-in. disks, for large-size pattern work. Devices are provided for duplicating work and for circular sanding. A special fence for sanding duplicate pieces to size, and for duplicating certain angles, is furnished as regular equipment. The circular-sanding attachment consists of a metal plate with a tongue to fit a slot in the table, and thus permits using the entire surface of the disk for circular sanding. The plate has a series of staggered holes to receive center pins, so that any diameter within the capacity of the machine may be sanded either square or to any angle to which the table will tilt. Hoods surround the disks for safety and for carrying the dust to the exhaust. The hoist is made a part of the machine to facilitate changing or mounting of disks. Garnet or other abrasive sheets are cemented to the metal disks, and these are easily replaced when worn.

PATENTS

JUNE 30, 1931

Metal-Working Machinery

Portable Cutting and Welding Machine. James L. Anderson, Tenafly, N. J., assigned to Air Reduction Co. Patent 1,811,835.

Speed Control Device for Grinding Machines. Albert G. Belden and Glenn C. Naromore, Worcester, Mass., assigned to Norton Co. Patent 1,811,873.

Vertical Spindle Machine Tool. Edward P. Bullard, Jr., Stratford, Conn., assigned to The Bullard Co. Patent 1,811,876.

Adjusting Device for Cylinder Grinders. Fred M. Kern, Detroit, Mich., assigned to Hutto Engineering Co. Patent 1,811,943.

Spring Mounting for Presses and the Like. George F. Wales, Buffalo, N. Y. Patent 1,811,987.

Grinding Machine. Waldo J. Guild, Worcester, Mass., assigned to The Heald Machine Co. Patent 1,812,003.

Punching and Upsetting Machine. Elmer S. Seavey, Bethlehem, Pa., assigned to Bethlehem Steel Co. Patent 1,812,023.

Machine for Riveting Spokes of Vehicle Wire Wheels. William N. Booth, Detroit, Mich., assigned to Kelsey-Hayes Wheel Corporation. Patent 1,812,032.

Apparatus for Shaping Sheet Metal. Otto J. Groehn, Grosse Pointe Park, and Lawrence S. Lamb, Grosse Point, Mich., assigned to Hudson Motor Car Co. Patent 1,812,045.

Die Press. Otto J. Groehn, Grosse Pointe Park, Mich., assigned to Hudson Motor Car Co. Patent 1,812,046.

Method of and Apparatus for Making Castings and Handling and Conditioning the Molding Sand Therefor. Max Sklovsky, Moline, Ill., assigned to Deere & Co. Patent 1,812,121.

Continuous Automatic Shearing Machine. Frank H. Streine, New Bremen, Ohio, assigned to The Streine Tool and Manufacturing Co. Patent 1,812,122.

Method of and Machine for Cutting Holes. Hermann Hentschel and Hans Greggersen, Hamburg, Germany, assigned to the Firm Autogen Gasaccumulator Aktiengesellschaft, Berlin, Germany. Patent 1,812,239.

Electric Welding Apparatus. Henry S. Holmes, New York, N. Y., assigned to Thomas E. Murray. Patent 1,812,295.

Grinding Machine. William Arter, Worcester and Warren F. Fraser, Westboro, Mass.; said Fraser assigned to Arter Grinding Machine Co. Patent 1,812,313.

Coil Winding Machine. Hoxsie W. Lillibridge, Philadelphia, Pa., assigned to Atwater Kent Manufacturing Co. Patent 1,812,349.

Balancing Machine. Francis T. McDonough, Madison, Wis., and Amos F. Moyer, Minneapolis, Minn., assigned to Precision Balancing Machine Co. Patent 1,812,353.

Grinding Machine. Maxwell I. Mathewson, Providence, and Arthur Brown, Cranston, R. I., assigned to Brown & Sharpe Manufacturing Co. Patent 1,812,444.

Drop Hammer. Frederic C. Billings, Hartford, Conn., assigned to The Billings & Spencer Co. Patent 1,812,464.

Lock Washer Untangling Device. Arthur O. Brooke, Detroit, Mich., assigned to General Motors Corporation. Patent 1,812,468.

Sheet Metal Working Machine. Paul R. Hahnemann, Buffalo, N. Y., assigned to Niagara Machine & Tool Works. Patent 1,812,479.

Feed Mechanism for Drilling Machines and the Like. Wilson P. Hunt, Moline, Ill., assigned to Moline Tool Co. Patent 1,812,533.

Milling and Drilling Machine. George Melling, Jackson, Mich. Patent 1,812,601.

Machine and Method for Assembling Springs. George A. Stackhouse, Oakland, Calif., assigned to L. A. Young Spring & Wire Corporation. Patent 1,812,611.

Saw Filing Machine. Sinibaldo Leone, Paterson, N. J. Patent 1,812,636.

Adjusting Means for Overhanging Arms. Benjamin P. Graves, Cranston, R. I., assigned to Brown & Sharpe Manufacturing Co. Patent 1,812,649.

Feed Mechanism for Machine Tools. Albert B. Leet, Rockford, Ill., assigned to Rockford Machine Tool Co. Patent 1,812,656.

Thread Cutting Means for Automatic Screw Machines. Judson H. Mansfield and Chester F. Penrose, Rockford, Ill., assigned to Greenlee Bros. & Co., Rockford, Ill. Patent 1,812,660.

Machine Tool for Milling. Edward J. Kearney, Wauwatosa and Joseph B. Armitage, Milwaukee, Wis., assigned to Kearney & Trecker Corporation. Patent 1,812,702.

Tools and Attachments

Mechanism for Truing and Dressing Grinding Wheels. Ferdinand J. Hohnhorst and Ferdinand J. Kroeger, Covington, Ky. Patent 1,811,933.

Chuck. Richard H. Jellicoe, Worcester, Mass., assigned to The Heald Machine Co. Patent 1,812,006.

Chuck. Dwight C. Page and Richard H. Jellicoe, Worcester, Mass., assigned to The Heald Machine Co. Patent 1,812,017.

Grinding Wheel. Alan P. Beebe, Detroit, Mich., assigned to The Peninsular Grinding Wheel Co. Patent 1,812,076.

Machine for Perforating Rim Lugs. William N. Booth, Detroit, Mich., assigned to Kelsey-Hayes Wheel Corporation. Patent 1,812,133.

Chuck. Schuyler H. Earl, Rochester, N. Y., assigned to Gleason Works. Patent 1,812,144.

Means for Producing Curve-Threaded Nuts. Elis Helin, Stockholm, Sweden, assigned to Carl Kindstrom, Stockholm, Sweden. Patent 1,812,147.

Lathe Dog. Charles R. Taggart, San Francisco, Calif. Patent 1,812,180.

Drill Chuck. Frederick W. Spencer, Chicago, Ill. Patent 1,812,221.

Taper Turner. George A. Perry, Springfield, Vt., assigned to Jones & Lamson Machine Co. Patent 1,812,366.

Projecting Mechanism and Gear Staging Device. Russell W. Porter and Robert O. Beardsley, Springfield, Vt., assigned to Jones & Lamson Machine Co. Patent 1,812,369.

Diaphragm Chuck. Byron F. Stowell, Springfield, Mass., assigned to Van Norman Machine Tool Co. Patent 1,812,455.

Core for Metal Casting Molds. Charles L. Lee, Dayton, Ohio, and Thomas C. Van DeGrift, Detroit, Mich., assigned to General Motors Research Corporation. Patent 1,812,491.

Spring Winding and Setting Tool. Curtis McFarland, Felicity, Ohio. Patent 1,812,494.

Peening Apparatus. Edward W. Stevens, Detroit, Mich., assigned to Chicago Pneumatic Tool Co. Patent 1,812,726.

Furnaces

Furnace or Heat-Treatment Chamber Cooling Means. Edwin L. Smalley, Whitefish Bay, Wis., assigned to Hevi Duty Electric Co. Patent 1,811,979.

Annealing. Frank G. Carrington, Anniston, Ala., assigned to Ferric Engineering Co. Patent 1,812,320.

Means for Heating Steel for Hardening. Murray Winter, Wrentham, Mass., assigned to The Sentry Co. Patent 1,812,837.

Processes

Process for Treating Metallic Articles. Orin A. Bassett, Oklahoma City, Okla., assigned to The National Industrial Laboratories Corporation. Patent 1,811,909.

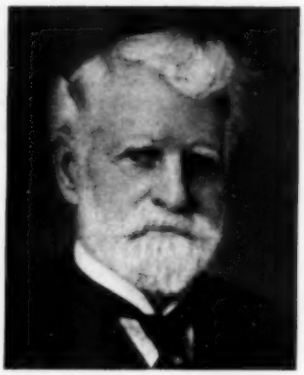
Method of Electrically Welding Thick Metal Plates. Richard Stresau, Wauwatosa, Wis., assigned to A. O. Smith Corporation. Patent 1,812,123.

Method of Welding. George T. Jacocks, Brooklyn, N. Y., assigned to Alco Products Incorporated. Patent 1,812,151.

Method for Manufacturing Curve Threaded Nuts and Means Therefor. Elis Helin, Liljeholmen, Stockholm, Sweden. Patent 1,812,205.

Process of Manufacturing Tungsten Carbide. Oscar L. Mills, Los Angeles, Calif., assigned to Mills Alloys, Incorporated. Patent 1,812,357.

NEWS



Swasey Gives $250,000 To Engineering Foundation

AMBROSE SWASEY, founder of The Engineering Foundation, has just added $250,000 to his previous gifts to the Foundation, bringing their total to three-quarters of a million dollars. In making this gift Mr. Swasey said: "It has been my privilege on previous occasions to assist in the endowment of this Foundation, and, having a high appreciation of the very practical and helpful results that have been already achieved, and believing that the broad and well-laid plans of the Foundation promise even greater service in the future, I now take great pleasure in making available to The Engineering Foundation, through United Engineering Trustees, Inc., an additional fund of $250,000 for the furtherance of research in science and engineering, or for the advancement in any other manner of the profession of engineering and the good of mankind."

Kearney & Trecker Plan T-C Tool Show

The Kearney & Trecker Corporation, Milwaukee, Wis., is planning a preview showing of a complete new line of "Milwaukee" milling machines at its plant on July 15, 16 and 17. The exhibit will be in the form of a Machine Tool Show, with 38 individual exhibits grouped at eight different stations. One of the features will be the operation of several production and knee-type machines with tungsten-carbide milling cutters. These set-ups will include actual floor-to-floor milling of production jobs with cutter speeds as high as 1,500 r.p.m. In addition, continuous moving pictures will show many other T-C milling jobs for various classes of products.

Metal-Working Machinery Exports Set New 1930 High

United States exports of metal-working machinery during 1930 amounted to $41,945,000, an increase of about 3 per cent over the figure of the previous year, 23 per cent above that of 1928, 240 per cent in excess of 1922, and greater than any year since the abnormal postwar year of 1920, according to the Industrial Machinery Division, Department of Commerce.

The feature was the substantial gain in exports of metal-working machinery to Europe, which amounted to over $30,000,000 or 72 per cent of the total. This trade was 20 per cent greater than similar exports in 1929, and 47 per cent in excess of 1928 shipments, due largely to increased Russian orders. The significance of this activity is particularly marked in view of the extremely competitive conditions existing in the countries involved. Since 1923, Europe has consumed annually more than 50 per cent of American exports of metal-working machinery in spite of the fact that manufacturers of similar equipment in the more highly industrialized nations of that area have been striving constantly to expand their export business through lower prices and long-term credits often supported by government guarantees.

For the third successive year, sales of American metal-working machinery to Latin America approximated $3,000,000. Mexico and Central America substantially increased their purchases in 1930 as compared with the previous year, while slight declines occurred in the South American trade. Despite a decrease of about 38 per cent in the amount of metal-working machinery purchased in 1930 as compared with 1929, Canada continued as the second most important grand division for this type of American equipment, a position which it has occupied since 1924. However, from the standpoint of individual countries, it dropped from first place in 1929 to third place in 1930, to be replaced by Soviet Russia and the United Kingdom.

Of the remaining grand divisions, slight decreases were registered in 1930 as compared with the previous year. In the case of Asia, sales were fairly well maintained, amounting to $2,400,000, thereby surpassing the totals established during the period 1925 to 1928, while falling somewhat below the 1929 level of $2,900,000.

The accompanying table affords a more detailed study of the relative values of the various foreign markets for American metal-working machinery for the period 1926-1930. The countries are listed in the order of their importance in 1930.

Country of Destination	1926	1927	1928	1929	1930
Soviet Russia in Europe	$537,931	$1,046,465	$1,193,388	$2,619,658	$14,187,251
United Kingdom	4,654,007	5,721,064	6,345,090	8,282,078	6,812,275
Canada	3,214,770	4,626,481	6,937,761	8,374,795	5,409,017
France	1,581,929	2,198,424	4,690,227	6,367,240	3,192,674
Germany	1,017,824	3,175,313	2,615,427	2,134,327	2,288,719
Japan	874,491	1,238,320	1,424,664	1,686,238	1,349,061
Italy	515,165	598,786	876,730	1,497,190	951,610
Mexico	637,964	335,760	540,895	603,688	779,161
Brazil	383,243	567,543	649,160	463,981	712,290
Sweden	329,776	386,037	535,847	1,120,477	580,851
Australia	918,395	939,958	669,279	580,896	468,177
Belgium	266,408	291,183	947,494	762,511	465,076
Czechoslovakia	107,127	156,425	801,761	658,439	429,414
British India	460,951	396,905	310,102	444,899	388,455
Spain	228,633	361,901	307,975	453,061	367,101
Chile	418,926	209,907	206,274	427,179	331,064
Argentina	252,148	406,865	524,694	547,993	302,396
Netherlands	109,981	296,789	460,377	625,550	231,665
British South Africa	323,506	288,668	317,604	349,900	216,106
Netherlands East Indies	95,918	123,667	245,880	375,076	207,165
Irish Free State	(1)	(1)	1,159,893	69,958	200,530
Switzerland	107,822	157,069	136,469	233,230	191,881
Venezuela	177,699	246,418	164,152	158,804	165,085
Soviet Russia in Asia	(1)	(1)	150,177	51,963	150,561
Cuba	209,386	201,477	132,503	157,755	143,643
Philippine Islands	72,846	114,302	123,033	140,155	123,649
Panama	33,593	42,412	100,527	87,996	107,110
Denmark	28,708	43,281	80,767	83,315	106,540
China	61,900	42,131	48,584	124,771	104,247
Netherlands West Indies	(1)	(1)	123,569	55,512	86,861
Norway	30,388	39,010	83,742	83,719	79,169
New Zealand	240,733	155,855	118,483	95,259	67,456
Colombia	139,485	218,055	136,579	105,996	62,362
Peru	202,189	133,960	120,844	123,195	48,596
Uruguay	15,356	13,553	36,872	57,973	46,738
Bolivia	21,840	20,519	73,480	73,580	40,890
Finland	(1)	(1)	67,857	52,891	38,315
British Malaya	22,728	20,715	39,813	52,837	23,134
Total including other countries	$18,867,522	$25,379,417	$34,124,809	$40,803,393	$41,945,398

(1) Included in other countries.

American Machinery Exports Show Increase in May

Washington, D. C.—July 7—Exports of power-driven metal-working machinery was one of the few items in the machinery schedule which showed an increase in May over April. In May the value of those exports was $2,798,049. In April the value of all exports was $2,463,122. Taking the schedule as a whole, May shows a decided falling off as compared with April, with agricultural machinery and automobiles furnishing the more conspicuous declines.

Exports of machinery, including tractors and automobiles, in May were valued at $42,238,692. This is a decrease of $8,500,000, as compared with the value of similar exports in April and a decrease of $41,000,000 as compared with May of 1930. Comparative figures, taken from returns from the Department of Commerce, for the major sub-divisions of these exports, follow:

	May, 1930	May, 1931
Electrical machinery and apparatus	$10,976,938	$8,189,222
Power generating machinery, except electric and automotive	2,513,171	1,884,522
Construction and conveying machinery	2,687,914	1,034,516
Mining, oil well and pumping machinery	4,831,933	2,064,090
Textile machinery	634,002	721,796
Sewing machines	766,907	343,330
Office appliances	3,751,815	2,123,677
Typewriters	1,485,955	866,728
Printing and bookbinding machinery	1,784,528	998,754
Agricultural machinery	9,593,635	2,489,828
Tractors and parts	3,133,465	363,291
Automobiles and other vehicles	33,517,991	15,618,099

The only instances of increases were: power-driven metal-working machinery, $335,000; power generating machinery, $800,000; sewing machines, $19,000; printing and bookbinding machinery, $38,000. Detailed figures for the power-driven, metal-working machinery group are:

	May, 1930	May, 1931
Engine lathes	$616,374	$72,065
Turret lathes	229,890	178,001
Other lathes	218,653	85,615
Vertical boring mills and chucking machines	20,641	111,507
Thread cutting and automatic screw machines	94,310	16,997
Knee and column type milling machines	78,689	46,919
Other milling machines	330,165	247,368
Gear cutting machines	119,935	205,827
Vertical drilling machines	66,833	49,918
Radial drilling machines	15,145	35,818
Other drilling machines	126,654	114,751
Planers and shapers	107,311	48,518
Surface grinding machines	28,838	23,651
External cylindrical grinding machines	201,580	61,645
Internal grinding machines	108,422	109,547
Tool grinding, cutter grinding and universal grinding machines	185,854	123,654
Sheet and plate metal working machines	421,230	333,071
Forging machinery	164,640	183,551
Rolling mill machinery	122,488	77,238
Foundry and molding equipment	186,663	392,083
Other power-driven metal-working machinery and parts	889,277	235,512

The items making up the May increases over April were: turret lathes, vertical boring mills and chucking machines; gear-cutting machines; vertical drilling machines; external cylindrical grinding machines; internal grinding machines; tool grinding, cutter grinding and universal grinding machines; sheet and plate metal-working machines and foundry and molding equipment.

It will also be noted that certain items in May of this year exceeded exports of those items in May of 1930. They were radial drilling machines, internal grinding machines, and forging machines.

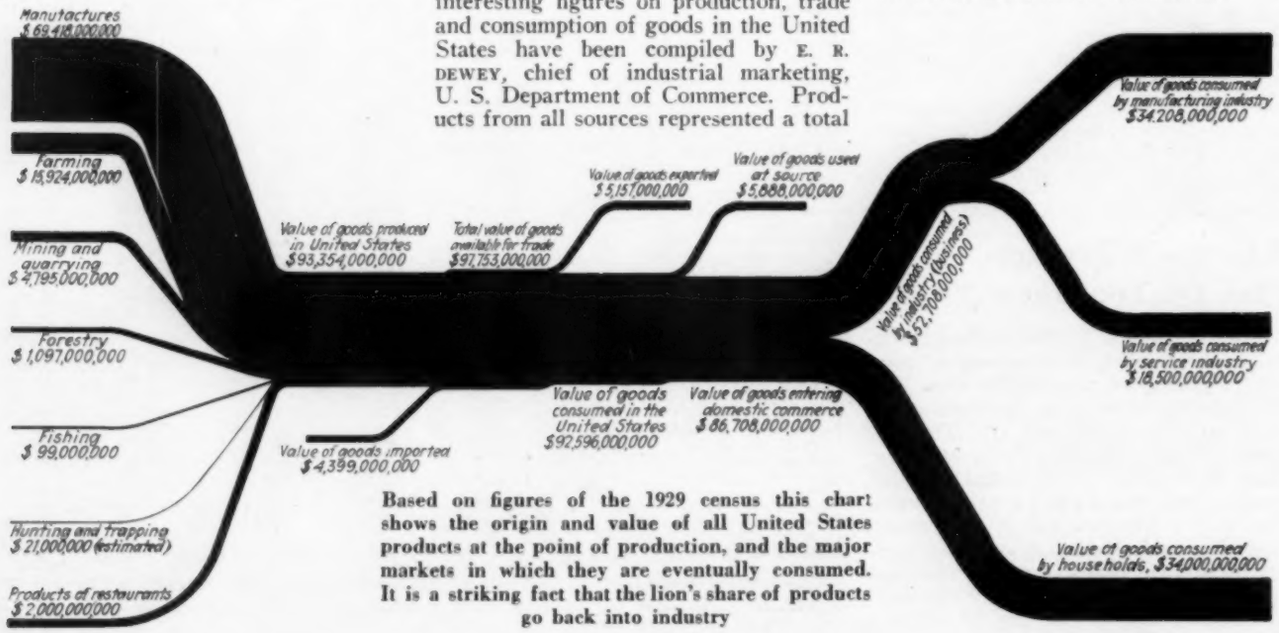
Marketing Survey Traces Flow of U. S. Products

Based on figures of the 1929 census, interesting figures on production, trade and consumption of goods in the United States have been compiled by E. R. DEWEY, chief of industrial marketing, U. S. Department of Commerce. Products from all sources represented a total value of over 93 billion dollars. Nearly 75 per cent, or 69 billion dollars, consisted of products of various manufacturing processes. Farm products amounted to nearly 16 billion dollars, mines and quarries produced over 4¾ billion dollars; products of forests, fishing, hunting, trapping and restaurants accounted for the balance. With $4,399,000,000 of imported goods added, there were in 1929 goods amounting to $97,753,000,000 available for trade, all of these figures representing value at the point of actual production or import.

This impressive volume of goods found consumption in four major fields. The export trade took $5,157,000,000, or 5.28 per cent. Products consumed at their source, such as corn fed to cattle, coal burned at the mine, etc., amounted to $5,888,000,000, or 6.02 per cent. Goods valued at $86,708,000,000 at their source, 88.7 per cent of the grand total, entered domestic commerce in the form of one or the other of the 3,000-odd different items classified.

A total of $34,000,000,000, or 34.78 per cent of the grand total, was produced for sale to "household markets" as finished products for domestic household consumption. The remaining $52,708,000,000, representing 53.92 per cent of the grand total, consisted of materials such as leather, cotton, oil, hides, wool and machinery, absorbed by the industrial or business user. Of this "industrial" total, the service industries accounted for $18,500,000,000. The balance of $34,208,000,000 were sold to manufacturers for business consumption. It is, however, important to understand that the total figures here presented reflect a number of duplications.

For instance, the value of a bushel of grain appears first as part of the total of farm products, then becomes an element of sales to manufacturing industries; later it reappears in the form of flour, and perhaps may become part of sales to manufacturing industries, to be sold to a household consumer.


Manufactures $69,418,000,000
Farming $15,924,000,000
Mining and quarrying $4,795,000,000
Forestry $1,097,000,000
Fishing $99,000,000
Hunting and trapping $21,000,000 (estimated)
Products of restaurants $2,000,000,000
Value of goods produced in United States $93,354,000,000
Total value of goods available for trade $97,753,000,000
Value of goods exported $5,157,000,000
Value of goods used at source $5,888,000,000
Value of goods imported $4,399,000,000
Value of goods consumed in the United States $92,596,000,000
Value of goods entering domestic commerce $86,708,000,000
Value of goods consumed by industry (business) $52,708,000,000
Value of goods consumed by manufacturing industry $34,208,000,000
Value of goods consumed by service industry $18,500,000,000
Value of goods consumed by households, $34,000,000,000

Based on figures of the 1929 census this chart shows the origin and value of all United States products at the point of production, and the major markets in which they are eventually consumed. It is a striking fact that the lion's share of products go back into industry

Machines Take Important Place At Milan Fair

BY OUR BERLIN CORRESPONDENT

Italy, once purely an agricultural state, is increasing its industralization steadily, as evidenced by the increasing importance of the annual Milan Fair. The recently terminated 12th Milan Fair had 3,300 Italian and 1,000 foreign exhibitors. While during former periods the agricultural and silk industries were the chief points of interest, the machine industry was this year one of the most important exhibiting groups, especially the machine tool, textile machinery, and agricultural implement divisions. Among these, the machine tool industry occupied first place. Included among them were some 25 American firms, most of which, however, did not occupy their own booths, but were represented by Italian firms, principally by Emanuele Mascherpa, via Pergolesi, Milan. German machinery manufacturers were also well represented, almost 100 firms having exhibits. This heavy participation of the Germans is not so astonishing if the accompanying statistics of Italian machinery imports from 1927 to 1930 are studied, in which the Germans take the largest share.

Italian Machinery Imports 1927-1930

	1927	1928	1929	1930
U. S....	$4,275,000	$5,120,000	$7,200,000	$4,960,000
France	5,170,000	4,890,000	5,110,000	3,800,000
England	4,690,000	6,460,000	7,860,000	6,120,000
Germany	14,830,000	16,400,000	22,050,000	19,450,000
Switzerland	2,750,000	3,390,000	3,595,000	3,215,000

Of these totals, the following represent the machine-tool imports alone:

(a) non-automatic	2,415,000	3,545,000	4,660,000	3,185,000
b) automatic....	260,000	458,000	598,000	410,500

of which by far the greatest part comes from Germany.

Inquiry regarding the reasons for this apparently extraordinary preference for German products in Italy results in the explanation that Italy is obliged to buy such quantities of German goods since Germany is Italy's best customer, buying especially quantities of Italian agricultural produce, artificial silk, small motors, automobiles, and similar products. Germany has, therefore, come to a preferential agreement with Italy with regard to customs duties. For instance, on some groups of machinery not manufactured in Italy, Germany enjoys a 30 per cent lower rate of duty than, say, the United States. Germany takes about 13 per cent of Italian exports; Italy, however, only 4 per cent of German exports. In Italian export statistics, Germany with 79 million dollars precedes the United States with 68 million, France with 63 million, Great Britain with 58 million, and Switzerland with about 47 million. In Italian imports the United States occupies first place, followed closely by Germany and far behind by other countries. Commerce with Germany is thus much more favorable for Italy than with France, Czechoslovakia or other nearby countries.

Germany hopes to increase its sales in all industrial products at the cost of other countries' exports to Italy, as soon as the customs union with Austria is perfected, since then German customs frontiers will reach right up to the Italian ones.

While America exhibited chiefly machine tools, Germany also showed textile machinery (being very important because of Italy's large textile industry), printing and paper elaborating machinery, road construction equipment, and machinery for the food industry. The Fair so far has not shown results in the way of concrete orders, being similar to the 1931 Leipzig Spring Fair in that respect. As soon as general conditions improve, all pending projects will be executed, and there are a great many of them. The Italian Government has already undertaken keen measures to improve the position. For example, all Government officials' salaries have been reduced by 12 per cent as of Dec. 1, 1930, those of private employees by 10 per cent, and of workmen by 8 per cent. As a result, considerably lower prices reign for many articles. The Italian Government thus hopes to suit the price to the present purchasing power of the now stabilized Italian lira.

All in all, one may say that business prospects in Italy are good, as soon as the present economic crisis has ended, and that the Milan Fair offers a good chance for capturing the Italian market. The Milan Fair does not advertise in foreign countries, as does the Leipzig and similar fairs, since it is visited chiefly by Italian buyers.

Auto Output Falls

Production of motor vehicles in the United States during May showed a decline of 20,593 units. Reductions were shown in the output of all types, the May drop following a constantly upward trend in all preceding months. May production was 315,115 units, compared with 335,708 units in April. Passenger cars were 269,080, as against 285,028 the previous month; trucks, 45,695, as against 50,015 in April; and taxicabs 340, compared with 665 in April.

No Freight Revision Until Late This Year

BY OUR WASHINGTON CORRESPONDENT

The protracted schedule of hearings on the 15 per cent freight rate increase proposed by the railroads postpones the possibility of any upward revision until late in the year. Hearings will commence July 15 in Washington for the purpose of receiving the evidence of the railroads, their security owners and others favoring an increase in rates in the hope that it will raise revenue sufficiently to protect the ratio of 1½ between earnings and fixed charges upon which the credit of the railroads, and consequently, the maintenance of efficient service depend.

Shippers and others opposed to an increase in freight rates will be heard in further hearings commencing July 20 in Washington. As the Interstate Commerce Commission also is planning to hold hearings at other points throughout the country the prospect is that the proceeding will be considerably prolonged.

Belief prevails in Washington that the Commission will not make a decision on the railroad's proposal until it deems that general business conditions have improved sufficiently to warrant its denial.

Measures intended to provide immediate relief from unemployment will be outlined in a report that the public relations committee of the American Engineering Council is preparing in its campaign against unwise labor legislation. A subcommittee, of which F. J. CHESTERMAN, vice-president and general manager of the Bell Telephone System of Pennsylvania, is chairman, recently held a meeting in Pittsburgh.

One of the committee's proposals is to select and describe several plans by which private industries can mitigate unemployment, and to place such plans before the engineers of the country with the suggestion that some one of them may be applicable to the operations of a particular industry or firm. Associated with Mr. Chesterman on this committee recently appointed for dealing with the present unemployment situation are W. R. WEBSTER, Bridgeport Brass Co., E. R. RUTH, American Oak Leather Co., GEN. R. C. MARSHALL, and L. W. WALLACE, Council's secretary.

Foundry Standards Committee Appointed

The organization of the sectional committee on standardization of foundry equipment has just been completed under the procedure of the American Standard Association. E. S. CARMAN, president of Edwin S. Carman, Inc., Cleveland, is chairman of the committee, and JOHN J. BAUM, development engineer of the Steel Founders Society of America, is secretary. The work of the committee has been divided between three sub-committees, which will cover the following subjects:

Subcommittee 1—Pattern plates, molding machine parts, affecting interchangeability of patterns, flask pins and holes, general dimensions of stock flasks for jobbing work.

Subcommittee 2—Ladle and ladle shank sizes, ladle sleeves, stoppers and nozzles.

Subcommittee 3—Stock core print sizes, shapes and finish allowances, pattern markings, rapping plates, fillet sizes, dowel pins for metal patterns and metal core boxes.

The project is under the joint sponsorship of the American Foundrymen's Association of the A.S.M.E.

C. E. SKINNER
New President, A.I.E.E.

Fiscal Year Ends; Debt 16 Billions

With an average interest rate on the public debt of about 3.58 per cent on July 1, 1930, the Government completed the fiscal year on June 30. The outstanding debt June 27, the last day for which official figures were available, amounted to about $16,796,000,000, compared with $16,185,390,800 at the close of the fiscal year 1930. The daily treasury statement of June 27 showed a deficit of $867,906,122.

Metallurgist

The United States Civil Service Commission has opened a competitive examination for principal metallurgist for vacancy in the Bureau of Mines, Department of Commerce, with a salary range of $5,600 to $6,400 a year. Applications must be submitted not later than July 24.

BUSINESS ITEMS

The Keller Mechanical Engineering Corporation, 70 Washington St., Brooklyn, N. Y., will be closed from July 18 to Aug. 2 for the annual vacation period.

Extensive additions are to be made to the plant of Vancouver (B. C.) Wire Rope Works, Ltd., because Wrights Wire Ropes, Ltd., Birmingham, England, intends to manufacture all its products for Canadian sale at the Vancouver plant.

Corporate Steel Products, Ltd., Montreal, has purchased the business of the Ottawa (Ont.) Sheet Metal Works. Corporate Steel Products is a newly formed holding company for Western Steel Products which owns or controls 11 plants engaged in manufacture of steel products.

The American Brass Co., Waterbury, Conn., plans a $3,000,000 construction program during 1931, 32 and 33. Of this, $600,000 is involved in construction now under way at Ansonia, Conn. The latter town is to be the center of the company's operations, replacing Waterbury.

The Armstrong-Blum Manufacturing Co., 333-357 North Francisco Ave., Chicago, Ill., has purchased the entire business of the Industrial Machine Co., Chicago, and will handle all business pertaining to "Industrial" tapping machines, surface grinders and reaming machines. The trade name of these machines will be changed to "Marvel" in the near future.

PERSONALS

C. G. BACON, director of wheel research, Armco Railroad Sales Co., has resigned, but is being retained in a consulting capacity in connection with wrought steel wheels.

J. W. DAVIS has been appointed Ohio representative, with offices at 1302 Ontario St., Cleveland, of the Synthane Corporation, Oaks, Pa., manufacturer of laminated Bakelite products.

F. CLIFFORD ESTEY has been appointed sales engineer of the Illinois Zinc Co., 332 South Michigan Ave., Chicago, Ill., his first activity being the promotion of the use of "Eraydo" alloy.

FRED J. GRIFFITHS, president of the Republic Research Corporation, Massillon, Ohio, since April, 1930, has been made a director of the Eaton Axle & Spring Co., Cleveland. He was formerly chairman of the Central Alloy Steel Corporation, now part of the Republic Steel Corporation.

C. H. CHAMPLAIN

J. M. HIPPLE

J. M. HIPPLE, works manager of the East Pittsburgh works, Westinghouse Electric & Manufacturing Co., since 1927, has been appointed general works manager. He has been succeeded by C. H. CHAMPLAIN, manager of the Sharon works, for the past eight years. M. L. FAWCETT succeeds Mr. Champlain at Sharon.

HARRISON HOBLITZELLE, executive vice-president of the General Steel Castings Corporation, left recently on a 6-week business trip to Europe.

J. C. C. HOLDING, vice-president and manager of the American Stainless Steel Co., Pittsburgh, left recently on a 30-day business trip to England.

JOHN L. JONES, formerly manager of the Lansing (Mich.) Foundry Co., and lately with the foundry division of the Oakland Motor Co., has been added to the sales engineering staff of the Great Lakes Foundry Co., Detroit.

ALVIN M. KARSTENSEN, formerly Pacific Coast representative of the Truscon Steel Co., Youngstown, Ohio, has become Pacific district manager for the Campbell Industrial Window Co., New York City.

M. J. KEARINS, formerly associated with Whitman & Barnes, Inc., Detroit, Mich., has joined the combined Latrobe (Pa.) Tool Co., and the J. M. Carpenter Tap & Die Co., Pawtucket, R. I., in the capacity of president and general manager, with headquarters at Latrobe.

Resignation of C. W. KILLIAN as president of the Durabilt Steel Locker Co., Aurora, Ill., as of June 13, and reorganization of the company, founded in 1921, was announced last week. E. D. KASER, one of the founders, becomes president and general manager; V. C. KASER, vice-president; H. S. HATCH, treasurer and manager of sales; and W. H. GRAHAM, secretary.

E. H. LANG has been appointed factory superintendent of the Sharon, Pa., works of the Westinghouse Electric & Manufacturing Co., succeeding M. L. FAWCETT, who has been promoted to works manager. Mr. Lang was formerly assistant factory superintendent.

ROBERT MCMILLAN, for the past 21 years general purchasing agent of the Pittsburgh Steel Co., retired July 1 after 45 years in the steel industry in the greater Pittsburgh district. Previous to his connection with the Pittsburgh Steel Co., he was identified with the H. C. Frick Coke Co. and the American Steel & Wire Co.

CHARLES C. MOORE, for about 30 years president of C. C. Moore & Co. Engineers, Inc., San Francisco, has retired from active participation and has become chairman of the board. ELGIN STODDARD succeeds Mr. Moore.

E. A. THUMLERT has been added to the sales organization of the Fairfield Engineering Co., Marion, Ohio. He will specialize in design and sale of skip hoists, ash hoppers and gates. Mr. Thumlert was connected with the Beaumont Co. for some 16 years, for several years as secretary and general manager. He was later connected with the Palmer-Bee Co., of Detroit, as a special sales engineer. His headquarters will be at Marion, Ohio.

A. WACHSMUTH, vice-president and general manager of Western Steel and vice-president of Corporate Steel, is being transferred from Winnipeg to Montreal in the capacity of vice-president and general manager. Succeeding Mr. Wachsmuth, FRED J. WALKER, manager of the Winnipeg plant, becomes general manager of Western Steel.

FERD T. NEBEL is now sole owner of the Rahn-Larmon Co., 2941 Spring Grove Ave., Cincinnati, Ohio. Mr. Nebel has been president and general manager since the death of A. J. LARMON, former owner, eighteen months ago, and has been identified with the machine tool industry for the past 33 years, filling every position from office boy to president. The company was incorporated in 1899, and is engaged in the manufacture of engine and extension bed gap lathes and their attachments. It will be continued under the name of the Rahn-Larmon Co., with the new officers; FERD T. NEBEL, president and treasurer; C. K. NEBEL, vice-president; OLIVER M. DOCK, secretary. These, together with HORACE M. TODD and M. L. ALEXANDER, will comprise the board of directors.

FERD T. NEBEL

T. A. MORGAN, president of North American Aviation, Inc., has been elected president of the Curtiss-Wright Corporation, Buffalo, N. Y. C. M. KEYES has been made chairman of the executive committee.

OBITUARIES

SIR HUGH BELL, 87, famous British iron master, died suddenly in London, June 28.

ALBERT BARNETT, 48, core room superintendent, International Harvester Co., Richmond, Ind., died recently.

ARTHUR CHURCH, 72, secretary of the Baldwin Locomotive Works, Eddystone, Pa., died in Philadelphia, June 26.

WALTER E. COFFIN, mechanical expert for the National Malleable & Steel Castings Co., Cleveland, since 1896, died June 25 at Cleveland Heights, Ohio.

TRUMAN P. GAYLORD, 60, vice-president of the Westinghouse Electric & Manufacturing Co., and in charge of the radio division, died July 5. He had been connected with the company since 1900.

ALBERT GREGORY, 57, manager of the New York Belting & Packing Co., San Francisco, died June 13 there. Mr. Gregory had been with the company 36 years.

FINDLEY F. HARMAN, president of the Cleveland (Ohio) Metal Treating Co., died June 28.

FRANK HEMINGWAY, 54, chemical engineer and president of Robinson, Butler, Hemingway & Co., Bound Brook, N. J., died June 28 in New York City.

CHARLES H. JOCKMUS, 70, president of the Ansonia (Conn.) Manufacturing Co., screw machine products, died June 30 at New Haven. He founded the Ansonia company in 1893.

SETH A. LEONARD, 76, president and treasurer of the Leonard Electric Manufacturing Co., Cleveland, died June 27.

WILL F. LEWIS, 64, for the past 23 years superintendent of the roll designing department of the Duquesne Steel Foundry Co., Coraopolis, Pa., died in Pittsburgh, June 23. Mr. Lewis was previously connected with the Mackintosh-Hemphill Co., and the Cambria Steel Co.

HENRY W. MAYNARD, 48, industrial engineer and cost accountant, with the Gillette Safety Razor Co. as factory accountant and later as auditor from 1925 to 1930, and for the last year also manager of the industrial accountant department, Herbert F. French Co., Boston, Mass., died there July 2.

PROF. GEORGE FILLMORE SWAIN, 73, McKay professor of engineering at Harvard University and an authority on hydraulic engineering, died in Holderness, N. H., July 1.

JOHN E. STARR, 71, head of the Starr Engineering Co., New York, and former president and vice-president of the American Society of Refrigerating Engineers, died recently at his home, Mattatuck, L. I.

RICHARD GILPIN WOOD, 82, former president of the Allan Wood Steel Co., Conshohocken, Pa., and a descendant of James Wood, founder of Conshohocken, died June 30.

MACHINE REQUIREMENTS AND INDUSTRIAL CONSTRUCTION

Opportunities for Future Business

Calif., Alameda—Owens-Illinois Glass Co., 133 Kearny St., San Francisco, is having plans prepared for the construction of a factory at Fernside Tract here. Estimated cost $1,500,000. Private plans.

Calif., Los Angeles—O'Keefe & Merritt Co., 3700 Mines Ave., had plans made for a 1 story, 100 x 120 ft. addition to plant for the manufacture of stoves and ranges. G. J. Fosdyke, 1708 South Ardmore Ave., Engr.

Calif., San Jose—San Jose Cement Co. Ltd., E. H. Dettner, Pres., 835 Howard St., San Francisco, awarded contract for a cement plant initial capacity 3,500 bbls. here. Estimated cost $2,250,000. Kilns and mills will be furnished by Polysius Corp., Bethlehem, Pa.

Calif., Stockton—Stockton City School District, let contract for a 2 story, 60 x 144 ft. vocational school. Estimated cost $50,000. J. W. Clowdsley, Exchange Bldg. and J. Losekann, 1218 West Harding St., Assoc. Archts.

Fla., Jacksonville—McMullen Airways, plans the construction of a hangar and repair shop at South Jacksonville Air Terminal.

Ill., Ottawa—Bd. of Education, C. H. Kingman, 211 East Main St., will receive bids until July 15, for the construction of a manual training high school. Estimated cost $300,000. Llewellyn & Llewellyn, 38 South Dearborn St., Archts. Noted May 21.

Ind., Indianapolis—State Highway Dept., will receive bids until July 14, for the construction of a garage and service building at 520 West Market St. Estimated cost $150,000. Vonnegut-Bohn & Mueller, 610 Indiana Trust Bldg., Archts.

La., Baton Rouge—Standard Motor Co., plans a 1 story, 90 x 125 ft. addition to repair and service building. H. E. Schwarz, Slattery Bldg., Shreveport, Archt.

Mass., Barnstable — E. H. Corson, 6th and Elm Sts., New Bedford, is receiving bids for the construction of a 1 story, 65 x 100 ft. service garage, etc. at Barnstable Road and Lewis St. Estimated cost $50,000. L. LaBrode, 888 Purchase St., New Bedford, Archt. Noted July 2.

Mass., Belchertown—Commonwealth of Massachusetts, Dept. of Mental Diseases, is having preliminary plans prepared for an industrial building at State School. Estimated cost $52,000. Kendall, Taylor & Co., 209 Columbus Ave., Boston, Archts.

Mass., Brighton (sta. Boston)—International Harvester Co. of America, 61 North Beacon St., awarded contract for a 1 story, 85 x 195 ft. storage building, also addition to service station at Everett and Beacon Sts. Estimated cost $50,000. Noted June 18.

Mass., Roxbury (sta. Boston) — Roxbury Crossing Service Station, Columbus Ave., plans to rebuild 1 story service station and storage building. Estimated cost $50,000. Architect not selected.

Mass., Salem—Estate of Mary M. Creedon, P. Creedon, 428 Essex St., is receiving bids for addition to garage at 430 Essex St. Estimated cost $40,000. Andrews, Jones, Biscoe & Whitmore, 50 Congress St., Boston, Archts. Noted June 11.

Mass., Somerville (br. Boston)—City, J. J. Murphy, City Hall, plans the construction of a municipal garage. Estimated cost $100,000. Architect not selected.

Mass., Waverly — Commonwealth of Massachusetts, Dept. of Mental Diseases, 109 State House, is having preliminary plans prepared for the construction of a 2 story assembly building. Estimated cost $75,000. Desmond & Lord, 1 Beacon St., Boston, Archts.

N. J., Hackensack—Bergen Auto Co., E. W. Stiffens, Pres., 17 Banta Pl., postponed construction of a 2 story, 100 x 140 ft. automobile sales and service building at Main St. and Hackensack Ave. Estimated cost $150,000. A. E. Dore, 173 Main St., Archt. Maturity about September. Noted June 4.

N. J., Maplewood—Kroydon Co., Burnet Ave., postponed construction of 1 story addition to golf club factory. $40,000. D. A. Hopper, 22 Ridgewood Ave., Irvington, Archt. Maturity indefinite. Noted June 18.

N. J., Newark—F. A. Phelps, 21 Fulton St., Archt., will receive bids about Aug. 1, for the construction of a 2 story laundry plant and garage at Branford and Clifton Sts. for American Realty & Investment Co., c/o New Jersey Toilet & Towel Supply Co., 690 New St., lessee. Noted July 2.

N. J., Newark — Owner, c/o Autocar Sales Co., Ardmore, Pa., lessee, will build a 1 story, 100 x 300 ft. truck servicing building and garage at Jefferson and Melbern Sts. here. Estimated cost to exceed $50,000. Work will be done by day labor and separate contracts.

N. J., Oakhurst—S. Schultz, Colonial Terrace, Oakhurst, Ocean Township, plans the construction of a 1 story automobile repair shop and garage. Estimated cost $40,000. Architect not selected.

N. Y., Brooklyn — M. Astorita, 302 Sackett St., plans the construction of a 2 story, 70 x 100 ft. service garage at Third Pl. and Court St. Estimated cost $75,000. I. Brooks, 16 Court St., Archt.

N. Y., Brooklyn—Belfan Building Corp., B. Roth, Pres., is having sketches made for the construction of a 100 x 170 ft. service garage at Grant St. and Morgan Ave. Estimated cost $40,000. M. Klein, 65 Court St., Archt.

N. Y., Brooklyn—Camstall Construction Co., M. Stolitsky, Pres., 50 Court St., is having preliminary plans prepared for a 1 story, 100 x 105 ft. service garage at 88th St. and East 4th Ave. Estimated cost $40,000. P. Freshman, 50 Court St., Archt.

N. Y., Brooklyn—Court Sq. Sales & Renting Corp., c/o J. Weinstein, 26 Court St., plans the construction of a service garage at Boerum Pl. and Pacific St. Estimated cost $375,000. J. S. Kennedy, 157 Remsen St., Archt. Maturity about December or later.

N. Y., Brooklyn—H. M. Hillman, 188 Flatbush Ave. Ext., manufacturers of brass and copper products, will award contract about July 15, for alterations to storage building at Flatbush and Myrtle Aves. Erling Owre, 53 Fort Hill Circle, St. George, S. I., Archt. Noted June 25.

N. Y., Brooklyn—M. S. Kaplow, 3114 Ave. M., plans the construction of a 2 story service garage at West 4th St. and Ave. P. Estimated cost $40,000. I. Kallich, 375 Fulton St., Archt. Work will be done by day labor and separate contracts. Maturity about December. Noted June 18.

N. Y., Long Island — Constructing Quartermaster, Mitchell Field, will receive bids until July 23, for the construction of a group of buildings including machine shop, assembly shop, parachute building, photographic laboratory, radio building, paint, oil and dope house, quartermaster maintenance shop, warehouse and garage, etc.

N. Y., New York—Dept. of Water, Gas & Electricity, Municipal Bldg., plans the construction of a service building and garage at 155th St. and St. Nicholas Ave. Estimated cost $70,000. J. E. Kleist, 25 West 45th St., Archt.

N. Y., New York — National Screen Service Inc., 126 West 46th St., plans the construction of a 7 story, 98 x 100 ft. factory and office at 346 to 354 West 40th St. Estimated cost $250,000. J. M. Berlinger, 232 Madison Ave., Archt.

N. Y., New York—Randco Realty Corp., E. Alpern, Secy., 527 Tiffany Ave., is having preliminary plans prepared for a 1 story, 100 x 100 ft. service garage at Tiffany and East Bay Aves. Estimated cost $40,000. N. Rotholz, 155 East 42nd St., Archt.

N. Y., South Jamaica (mail Jamaica)—Dept. of Sanitation, Municipal Bldg., New York, plans the construction of a garage here. Estimated cost $400,000. Maturity early winter.

N. Y., Syracuse—International Harvester Co., E. B. Maloney, Br. Mgr., 118 Hawley Ave., plans the construction of a 1 story 80 x 300 ft. sales and service station. Estimated cost $150,000.

N. Y., Syracuse—Syracuse Light Co., South Warren St., awarded contract for a new office and shop building on Erie Blvd. Estimated cost $750,000.

N. Y., Tomkinsville (sta. Staten Island)—Dept. of Sanitation, Municipal Bldg., New York, will receive bids in fall for the construction of a garage here. Estimated cost $200,000.

N. Y., Tonawanda — Frontier Super Service Station Co., 275 Young St., plans to rebuild part of service and repair shop recently destroyed by fire. $50,000.

O., Columbus—Columbus Steam Pump Co., 83 West Broad St., awarded contract for a 1 story, 41 x 78 ft. plant for the manufacture of pumping machinery, parts, etc. Estimated cost $24,000.

O., Dayton—Dayton Socket Corp., c/o H. M. Wolfe, Reibold Bldg., plans a plant for the manufacture of lamp sockets and kindred specialties.

Okla., Oklahoma City — Oklahoma Aviation Service Inc., Municipal Airport, will soon receive bids for the construction of a 1 story, 120 x 140 ft. hangar including repair shop, etc. Estimated cost $35,000. Langbein & Johnston, Hightower Bldg., Archts.

Pa., Arnold—Bd. of Education, C. L. Cotton, Pres., will receive bids until July 13, for a 2 story, 23 x 120 ft. shop building for Trade school on Woodmont St. Estimated cost $150,000. P. R. L. Hogner, Smithfield Bldg., 6th and Smithfield Sts., Pittsburgh, Archt.

Pa., Carnegie—Superior Paper Products Co., is receiving bids for the construction of first unit of paper plant, 1 story, 80 x 180 ft. Estimated cost $50,000. Braziell & Anderson, 309 4th Ave., Pittsburgh, Archts.

Tenn., Nashville—Martin Garages Inc., R. E. Martin, plans the construction of a 7 story garage on Sixth Ave. Estimated cost $200,000. Marr & Holman, Stahlman Bldg., Archts.

Tenn., Nashville — State of Tennessee, had plans prepared for the construction of a group of buildings including administration building and auditorium, agricultural and industrial building, etc. Estimated cost $1,000,000. W. R. McCornack, 10006 Carnegie Ave., Cleveland, O., Archt.

Tex., Cuero—Cuero Bag Awning & Tent Co., plans the construction of a 1 story, 60 x 110 ft. factory. Private plans. Machinery and equipment to cost $12,000 will be purchased.

Tex., Galveston — Stability Leather Goods Mfg. Co., 2705 Olive St., St. Louis, Mo., is having preliminary plans prepared for the construction of a leather goods factory here. Estimated cost $100,000. Private plans.

Wash., Spokane — Armstrong Machine Co., 3201 East Riverside St., plans to rebuild part of plant recently destroyed by fire. Loss $70,000.

Wis., Bayfield—Bayfield Mfg. Co., will soon start work on a 60 x 275 ft. plant for the manufacture of millwork, sash, doors and other hardwood products.

Wis., Phillips—Windshield Heater Co., manufacturers of electrical automative devices, awarded contract for the construction of a 45 x 115 ft. shop.

Equipment Wanted

N. C., Elizabeth City — Foreman Blades Lumber Co.—complete equipment for planing mill destroyed by fire.